CIVIL ENGINEERING

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The Popham Hall Apartments at Scarsdale, N.Y., Where Speedy Erection Saved Money for Both Owner and Builder
Economic Factors in Construction of Concrete Buildings and Design of Welded Steel Frames Are Both Discussed in This Issue

Volume 8 — AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852 — *Number 4*

APRIL 1938

Among Our Writers

ALLEN J. SAVILLE was director of public works, Richmond, Va., in 1921–1924, and since then has been in private practice in that city. He engages in municipal engineering work and city planning, and serves as consultant for the Corporation Commission of Virginia on public utility rates and valuations. He was graduated from the University of Virginia in 1908.

GILBERT D. FISH may be credited with the design of the first large welded building in this country—the Sharon Building of the Westinghouse Electric and Manufacturing Co. (1926)—and the first welded railway bridge—at Chicopee Falls, Mass. He is a 1913 graduate of Columbia University, and served with the Corps of Engineers as lieutenant, captain, and major during the World War. He specializes in welded construction and is in partnership with Elwyn E. Seelye in New York.

QUINCY C. AYRES has been for 18 years in charge of the work in drainage, irrigation, and erosion control at Iowa State College. Earlier, he spent 8 years in active practice of swamp drainage and flood control. During the World War he served as lieutenant with various engineer combat regiments. Since 1933 he has spent his summers directing various emergency conservation programs. Among his writings is *Soil Erosion and Its Control* (McGraw-Hill, 1936).

ERNST GRUENWALD is a graduate of the Technical University of Vienna, Austria, and has designed many sports arenas, factories, and apartment houses in foreign countries. In the United States his work has included all phases of concrete design and construction. For some time he was a research associate of Prof. Duff A. Abrams. Since 1926 he has been concrete engineer for the Lone Star Cement Corporation.

C. G. PAULSEN has served with the U. S. Geological Survey since 1914—during the last 7 years, as chief of the Surface Water Division in Washington, D.C., directing the operations of 36 district offices. In 1918 and 1919 he was district engineer of the Survey's office in Atlanta, Ga., and from 1920 to 1930 he served in the same capacity in Boise, Idaho. He is the author of many water-supply papers of the Survey.

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ROGER H. GILMAN is at present with the Port of New York Authority, engaged in traffic analysis work. He was graduated from Harvard University in 1936 and last year attended the Harvard Bureau for Street Traffic Research as a research fellow.

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WILLIAM BOWIE retired from the U. S. Coast and Geodetic Survey in 1937 after more than 41 years of service, during 27 years of which he was chief of the Division of Geodesy in charge of control surveys of triangulation and leveling. He holds a number of honorary degrees and has received decorations from several foreign countries for his work in geodetic surveying and mapping.

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Something to Think About

A Series of Reflective Comments Sponsored by the Committee on Publications

The Balance Wheel

Engineer's Freedom from Bias Makes Him Invaluable in Combatting Factionalism

By ALLEN J. SAVILLE

MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS
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IN this day when all the world seems to be separating into hostile camps and men are urged to be either on one side or the other, it may be well worth while to think for a moment before we decide where we belong as engineers.

Nature herself has imposed inevitable distinctions that make for partizanship. Immediately will come to mind such factors as climate with its humidity and aridity, its heat and its cold; topography with its highland and lowland, seacoast, and great plains; and race, with its varied and often incompatible characteristics. To these divisive but largely unavoidable factors other artificial or man-made difficulties may be added. Cleavages between labor and capital, for instance, are not new, and they have been emphasized rather than reconciled in recent years. In fact, there is an unfortunate tendency to stir up strife, to pit small business against big, to range the "haves" against the "have-nots," to encourage a battle of government against public utilities, and the vertical proponent against the horizontal.

Both Advocate and Judge.—In this decidedly disjointed state of affairs that cries out for coordination and cooperation, the engineer is fitted by temperament and training to assume a leading role. He enjoys a peculiarly honorable position in the construction world, an acceptance by opposing interests, to one of which he himself is party—an almost unheard-of degree of confidence. As is common knowledge, every specification written by an engineer contains a clause reading generally as follows: "In any dispute arising between the owner and the contractor the decision of the engineer shall be final and binding on both parties."

Think for a moment about this, because it is a remarkable state of affairs. The engineer makes the plans and specifications for the owner and is paid only by the owner; and yet the contractor agrees in writing—indeed he puts up a bond—and says he will accept even an adverse decision of the man who is paid by the owner. That is, in a deal between buyer and seller a judge is set up who is paid by the buyer and is frequently a permanent employee on his payroll. This is a custom of many years' standing and we rarely hear of a contractor or a contractor's group even suggesting a change in this unique set-up.

Because of this time-honored relation, there develops in engineers from the start of their careers a detached viewpoint, a lack of partizan bias that few other groups can boast. They are judges between men and, although paid by one side, reserve to themselves the privilege of just decision. It is evident, then, that engineers belong to no particular economic group but are generally expected to rise above petty considerations of partizanship.

In this present-day world, torn with dissension and economic wars, the engineer, because of this long training in fair dealing, has a peculiarly valuable function to perform. As warring groups, whatever the field of conflict, find that war does not pay, they will look for someone who has this quality of detached judgment and decision to act as peacemaker.

Engineer's Viewpoint a Practical One.—There are other unusual and rather superior qualities that set the engineer apart. His whole energies and creative effort are devoted to constructive ideas. He has been trained not to tear down, but to build, to construct. His whole mind is devoted to improvement, not destruction. Obviously conditions cannot be improved without constructive thinking. Who but engineers and technical men are constantly and intelligently striving for improvement? There are many men who dream of betterment and perhaps strive for it, but the engineers not only dream and strive but intelligently accomplish it.

Some years ago a politician, it will be recalled, came out with his platform—an automobile, a radio, and two hundred dollars per month for every family in America. This was not a constructive idea but merely a wild dream. For real progress men's minds must be directed towards realistic ambitions. Engineers are peculiarly equipped to take a leading part in this worth-while effort.

Valuable Individualism.—Another interesting quality that sets engineers apart is their fundamental training in mathematics. Mathematics is an exact science, not subject to influence by the radio speaker, the newspaper editorial writer, or the emotional orator. None of these usual avenues of propaganda could destroy the fundamental fact that two plus two is four. A man's mind trained in this kind of thinking develops a habit of sifting out the facts. This very training tends to keep an engineer always looking for the fundamentals. It is this logical method of thinking that every engineer necessarily develops as he progresses in the profession. One trained in mathematics thinks first in terms of the truth, and this is a leading step towards the integrity which is so fundamental in our profession.

Engineers always develop first individually and then as a group. This is necessarily so because from his earliest experiences the engineer is given individual responsibility. As he develops he is put in a position of directing the efforts of other men and in this way he learns to know people and to understand the humanities. One of the requirements of membership in this Society, as in all the Founder Societies, is that each applicant must have had responsible charge of work for a number of years. The usual mechanic, although a very valuable member of society, does not individually have responsible charge of work, but works as one of a group.

Again, engineers develop a basic and unusual idea of finance. Their duties require that they spend large sums of other people's money. They never handle it in cash "across the counter," but rather as estimates and vouchers—that is, as figures instead of currency. As a result of this experience money loses the peculiar significance that it has to most people and becomes more or less a material of construction, or a mode of securing such material. Sometimes when engineers look at the amount of money that they control or direct, their own compensation seems insignificant and far from adequate. Some have suggested that the union idea should be adopted in order to remedy this apparent lack of appreciation on the part of employers.

But this is not a necessary development. The peculiar qualities already outlined demand that an engineer develop as an individual and that he have a very definite detachment in order to exercise his judgment without bias. So it may be that some much better method than that of unionizing can be developed to bring to the attention of the employer any cases of utter inadequacy of compensation. Nearly always these cases will arise on those jobs which are preliminary to real graduation into the engineering profession.

Success and Its Compensations.—Engineers as a whole have always had a higher conception of success than merely in terms of money earned. The business man, to a large degree, measures his advancement in money, but the engineer measures his rather in work accomplished and in the high regard that other men hold for his sound judgment and his unbiased viewpoint. In this day when money is apparently the sole measure of every activity, it seems rather idealistic to talk about other compensations. It would, however, be a sad day for the engineering profession if it lost this appreciation of the value of these other compensations.

As manufacturing and business become more and more highly organized, obviously there develops a greater need for engineering advice, not necessarily of a highly technical character but certainly involving those qualities which the engineer has developed and which are by no means usual. All engineers who have gained a position of responsibility have these qualities in greater or less degree.

Engineers, as a group, perhaps do not have the reputation of being godly men, because most of them know the economic value of aces back to back, or the importance of the number seven; but at the same time they have this established reputation for unbiased judgment, a clear appreciation of the facts, and a very definite desire at all times to make their judgments fair to all parties concerned. The enhancement of this reputation is of extreme importance to them as a group and as individuals as well. This should be preserved at all costs. Under no circumstances should it be sacrificed for a temporary financial advance. This would be contrary to all the traditions of our profession and in the long run would gain us very little, if anything.

Opportunity Ahead.—One basic fact, the engineer should realize, is extremely important today, and this is that it takes time to build a permanent structure. In this day of disorder and impatience, the engineer, by training and experience, knows that not only does it take time to develop a sound structure but that men must be trained, organizations set up, and plans must be worked out in detail in advance, if a successful enterprise is to result. To many of the younger men starting in the profession, especially those of ability, may come times when it seems that progress is very slow and that the jobs that are good are all filled. It is very interesting to reflect that those in the good jobs are growing older at exactly the same rate as those in the minor jobs; in fact, in this day they are actually growing older faster. The younger engineers, then, particularly should pay attention to their own preparation for these bigger jobs. They should keep their minds from bias, because it is inevitable that some of them will have to perform the functions now performed by the older men.

The essential fact that must always be borne in mind is that the engineer must protect his right to an unbiased view and a correct decision regardless of the result. Otherwise he will not be qualified to fill the position he has occupied for so many years. And as we go on developing our faculties for the exercise of functions we ought to perform, business and industry will more and more appreciate our value. Automatically compensation for the engineer will increase.

". . . A true engineer considers his duties as a trust and directs his whole energies to discharge the trust, with all the solemnity of a judge on the bench."

—JOHN B. JERVIS (1795–1885), M. Am. Soc. C.E., from an Address at the First Annual Convention of the Society in 1869—TRANSACTIONS, Vol. I, p. 151

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CIVIL ENGINEERING

APRIL 1938

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VOLUME 8 NUMBER 4

An All-Welded Multi-Story Building

Quantity of Steel 10 Per Cent Less Than Required for Riveted Design

By GILBERT D. FISH

MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS
CONSULTING ENGINEER, NEW YORK, N.Y.

MAKING his choice solely on the basis of relative costs, the contractor on the job described here selected all-welded construction in preference to riveting. Definite economies were made possible by the careful preparation, in advance, of welded connection details and fabrication schemes for the use of bidders. Mr. Fish's thorough description of these details should be of interest and value to steel designers in all types of work.

BY a coincidence, the first completely welded multi-story building in New York City was erected immediately before the adoption of the city's new building code recognizing welding. The structure comprised two new wings for the main building of the New York State hospital in Brooklyn, and as it was a project of the New York State Department of Public Works, it did not require approval of the municipal authorities.

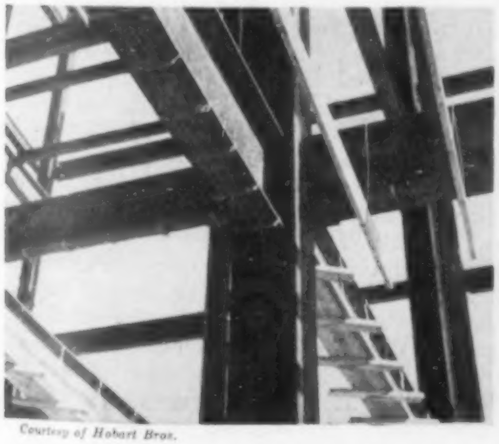
Plans and specifications for state buildings are prepared under the commissioner of architecture, William E. Haugaard, who for some years has recognized the growing importance of welding in building construction. A state armory of all-welded construction, located at Schenectady, was under contract when the plans for the Brooklyn hospital were being completed. On account of the greater size of the hospital job and in view of the fact that many contractors lacked experience in welding, Mr. Haugaard provided in the Brooklyn specifications for a contractor's option, permitting either riveted or welded construction without alternate bids.

In the case of a simple, heavy structure of beam-and-column type, welding does not ordinarily win in competition with riveting, unless the welded connection details and the scheme of fabrication and erection are thoroughly worked out in advance by one experienced in such work, and presented to bidders for their guidance in estimating. To improve the chances of welding for the Brooklyn job, the writer prepared estimating data, including complete connection details, and turned them over to steel contractors interested in bidding on arc-welded construction for the project. The lowest bid on steel was based on welding and was accepted by the contractor who received the award for construction as a whole.

The noiselessness of erection by welding was an undoubted advantage, in view of the fact that the new wings are immediately adjacent to a central tower housing some hundreds of mental patients and a numerous staff. This feature was not in any way responsible for the selection of welding, because the choice was left to the contractor and was determined by cost alone, without any pressure on the part of the authorities. The situation was therefore different from that at the Yale Medical Center and certain other hospitals, where welding has been used expressly to avoid noise.

Steel design, not including connection details, was made the same for welding as for riveting, except that many beams in the lower stories were slightly lighter in section for welding. The differences were few and small because the simple layout of the structure did not involve any plate girders, trusses, or other special features affording opportunities for design economies by welding. The reason for reducing the sections of numerous lower-story beams in the welding option was that they were determined as to strength by end bending moments involving wind stresses; riveted end connections would have weakened the beams by flange holes.

The two equal opposite-hand wings were designed for nine stories, including the basement, but only six stories could be built within the appropriation. The foundations, columns, and wind bracing were built as designed for nine stories, to permit later extension.



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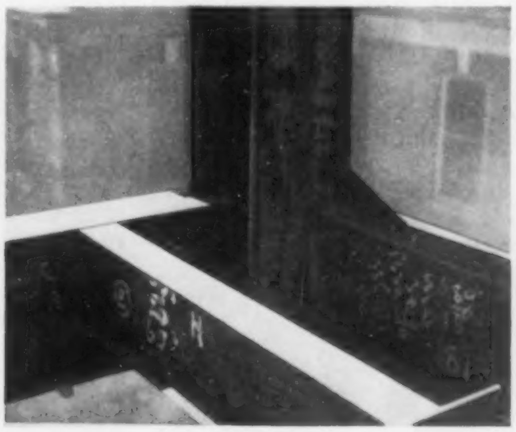


TYPICAL INTERIOR AND CORNER COLUMN CONNECTIONS

The total steel in both wings amounted to 612 tons—approximately 60 tons less than the weight required by the design for riveting. Most of the saving was in the connections, especially in the wind bracing. (New York State takes its wind bracing seriously and requires building frames to be designed to resist all wind pressure without assistance from walls and partitions.) In case a steel saving of 10 per cent, mostly in connections, seems a surprising difference, it may be pointed out that the beams were not very heavy and that the details shown for riveted wind bracing aggregated an unusually large tonnage in proportion to beam weight. In a building without wind bracing, riveted connections would probably not exceed 5 to 6 per cent of the total weight, and welding could not save more than four-fifths of that detail material.

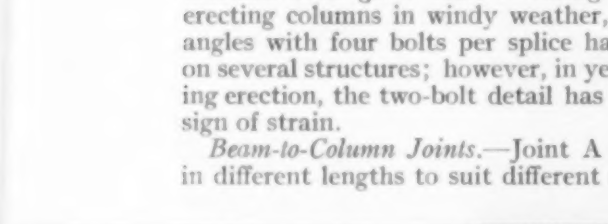
Structural steel work was completed in the spring of 1937, and the buildings are now nearly ready for occupancy. The wings are about 350 ft in combined length and 38 ft wide. Most of the beams are connected to columns, but there are numerous trimmer and header beams at floor openings. The floor consists of two-way reinforced-concrete joists and hollow terra-cotta blocks. Outer walls are of brick and terra-cotta.

In conformity with prevailing design standards, 18,000 lb per sq in. was used for direct stresses in rolled steel resulting from dead and live loads. In designing connections for dead and live loads, American Welding Society Stresses of 18,000 lb per sq in. for compression, 13,000 lb per sq in. for tension, and 11,300 lb per sq in. for shear were used for welds. For wind stresses alone, and for combinations of wind with other loads, unit stresses in welds and rolled steel were increased one-third.

Column Bases.—The general analysis of wind stresses assumed all columns to be fixed at their bases. The typical base detail (Fig. 1*a*) provided fixation. For the worst combination of maximum wind and minimum gravity loads, the welds joining the column directly to the slab and those joining it to the angles were sufficient to fix the column with respect to the anchor bolts, while the bolts in turn were strong enough, and the foundations stable enough, to insure restraint.

Column Splices.—Although calculations indicated that dead weight would prevent wind bending moment from causing column-flange tension at any splice section, the typical splice detail (Fig. 1*b*) provided enough welding at the corners to resist considerable stress. As all the columns were of the 12-in. series, the butt plates were of nominal thickness. On account of some complaints by ironworkers, that the small clip angles with only two erection bolts gave them a feeling of insecurity while erecting columns in windy weather, thicker and longer angles with four bolts per splice have since been used on several structures; however, in years of welded building erection, the two-bolt detail has functioned without sign of strain.

Beam-to-Column Joints.—Joint A (Fig. 1*c*), furnished in different lengths to suit different reactions, was used wherever a beam-to-column connection was concentric (or nearly so) and did not require wind bracing. All the interior beams along the corridors were connected with this type of joint.

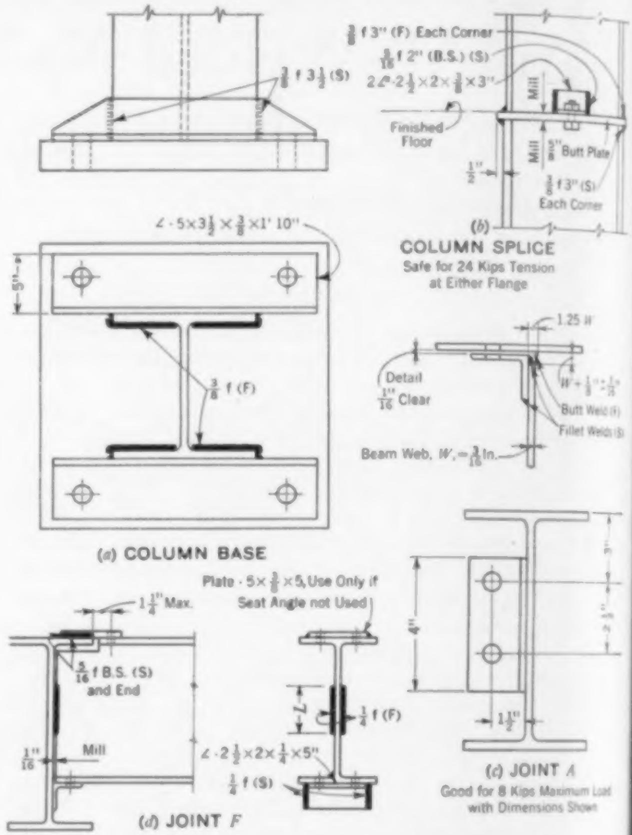


Courtesy of Hobart Bros.

WEST WING OF BROOKLYN STATE HOSPITAL, SHORTLY BEFORE COMPLETION OF STEEL WORK

Welding Is in Progress on the Fourth Floor

This detail, used with slight variations as a typical connection in about six structures during the last two years, has definite merits but also some drawbacks. The shop work is very simple, consisting of easy templet work on the clip angle, locating and welding the angle on the beam web, and punching the supporting member for erection bolts. The connection is simply designated on erection plans and shop drawings by the type letter and the length in inches, for example, "A6" for the 6-in. size of this type. The connection is widely applicable to most cases of beams supported by girder webs, column



(*a*) COLUMN BASE

(*b*) COLUMN SPLICE Safe for 24 Kips Tension at Either Flange

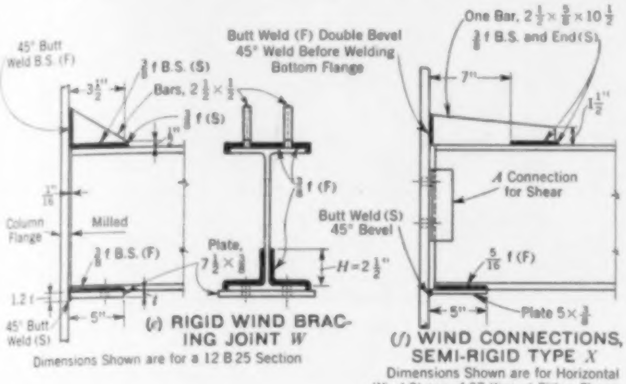
(*c*) JOINT A Good for 8 Kips Maximum Load with Dimensions Shown

(*d*) JOINT F

webs and column flanges, barring eccentric joints where column flanges are parallel with and too close to the webs of the supported beams. The shop weld at the end of the beam forms a convenient bevel for the field butt weld; the latter is the only field weld required and is determined as to section and length by the shop work, without need for field measurements. This joint is economical of connection steel, shop welding, and field welding; its efficiency lies mainly in the fact that the reaction is transmitted directly between beam and support, the clip angle being only an auxiliary element used for erection and for backing up the welding.

A design drawback of this connection is that it lacks flexibility and is therefore subject under some conditions to secondary bending stress due to beam deflection. The writer believes that, in case the throat of the weld at its junction with the beam web were undercut or thinner than the web, concentration of secondary stress might be dangerous. A practical inconvenience lies in the fact that mill-cutting variations in lengths of beams cause appreciable variations in the spaces to be welded and require detailing allowances which add to the volume of field welding. Another handicap, which causes some annoyance in erecting, is that the location of erection holes permits a limited amount of tilting of the beams; a little attention is sometimes needed for righting beams before welding.

Beam-to-Beam Joints.—Connection type *F* (Fig. 1*d*) was used wherever one beam supported another. The field welding in this type consists of a pair of fillet welds, which form a direct and exceedingly economical connection between the beam webs. The supported beam must be accurately cut in the shop, by milling or other means; some shops find such milling of groups of beams less expensive than the material and shop welding for connection pieces which might otherwise be used. The erection seat angle shown in the detail is used in preference to the top plate, wherever the supporting beam is deep enough.

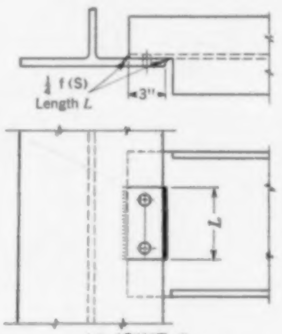


(*e*) RIGID WIND BRACING JOINT *W*
Dimensions Shown are for a 12 B 25 Section

(*f*) WIND CONNECTIONS, SEMI-RIGID TYPE *X*
Dimensions Shown are for Horizontal Wind Stress of 27 Kips at Either Flange

FIG. 1. CONNECTION DETAILS, WITH DIMENSIONS FOR TYPICAL DETAIL OF EACH SERIES

f = Fillet Weld; B.S. = Both Sides; S Indicates Shop Welding; F Indicates Field Welding

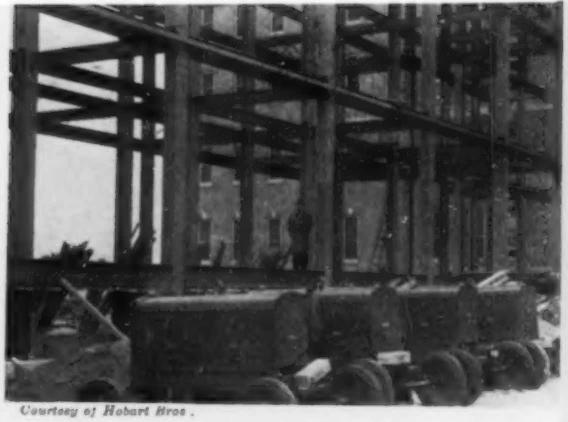


(*g*) JOINT *C*
Good for a Load of 4*L* Kips (3.5*L* Kips if Loads on Opposite Sides Do not Balance)

Rigid Wind-Bracing Joints.—The type *W* connections (Fig. 1*e*) were employed where wind bending moments made it necessary to develop all or nearly all of the bending resistance of the beams. They were designed in a series to suit groups of beam sections, the strength of each connection in bending at least equaling the bending strength of the largest beam in the associated group, and the shearing strength of the vertical welds of length *H* being sufficient for the maximum vertical shear occurring in any case in that building.

These *W* connections were designed, with respect to bending moment, by dividing the moment by the beam depth to determine the horizontal force at either flange, dividing this force by 17,300 lb per sq in. (the allowable wind tension in butt welds) to determine the cross-sectional area of connection steel at each flange, selecting suitable sections for plates and bars and determining their lengths to suit the fillet welds required to transmit the horizontal stress to the flanges. These connections, including the bars which projected considerably above the beams, did not extend above the floor filling into the cement finish. If shallower filling had been used, shallower top-flange connections would have been designed.

Semi-Rigid Wind Bracing Joints.—Where wind moments were much less than the safe bending resistances of the beams, it would have been extravagant to use rigid connections strong enough to fix the beams. On the other hand, it would have been unsafe to use rigid connections too weak to fix the beams. Therefore the semi-rigid type *X* (Fig. 1*f*) was employed to resist the wind moments, together with *A* joints, as previously described, to resist vertical shearing stresses.


Courtesy of Hobart Bros.

WELDING IN PROGRESS; ONE ARC IS VISIBLE ON THIRD FLOOR

The yielding element was a free length of connecting plate on the top flange, designed to yield in tension sufficiently to accommodate the deflection of the beam under gravity loads, without thereby suffering injury or losing its ability to resist horizontal tension and compression caused by wind. The free length of about $6^1/_2$ in. was about $^1/_{32}$ of the maximum beam span; with this ratio, the maximum stretch due to full gravity-load deflection would not much exceed 1 per cent. The dimensions of the connection plates and welds were determined to suit the horizontal wind forces, according to the same general method described for the rigid connections.

Spandrel-Beam Joints.—Connection type *C* (Fig. 1*g*) was used for nearly all outer-wall beams, except a limited number requiring wind bracing. The systematic location of spandrel beams at a uniform distance from column centers and the constant dimension between inside faces of column flanges made this extremely simple detail generally applicable.

Miscellaneous Notes.—A few miscellaneous connection types occurring in this building do not appear in Fig. 1. Among these were corner-column connections with eccentricity exceeding half the column width, wind-braced spandrel joints, and brackets supporting brick shelves.

The two equal wings of the addition were erected successively. Erection of the east wing began in the last week of December 1936; welding in that wing was started on January 4, 1937, and completed on February 10, rain and snow having interrupted the work for days at a time. Erection of the west wing was started shortly before the middle of March, and welding was essentially completed on April 7. Prevailing high winds and low temperature made work on both wings uncomfortable and retarded progress somewhat. The welding time in man-hours, not including time of foreman and engineer, who did no welding, was 435 for the east wing and 348 for the west wing. Each wing included 306 tons of steel.

Shop welding was divided between fillet welds and butt welds, as follows: Fillet welding, 3,240 lin ft; butt welding, of single bevel type with 45-deg angle, 400 lin ft. The total shop welding amounted to 2,440 cu in. in theoretical volume, averaging 4.0 cu in. per ton.

Field welding also included both fillet and butt welds, for a combined total of 3,150 ft in length. The theoretical volume of these welds averaged 3.9 cu in. per ton.

As previously mentioned, Commissioner Haugaard supervised the preparation of plans and specifications. Raymond J. Keays was in charge of structural design. Construction was supervised by the Division of Engineering, under Chief Engineer T. F. Farrell. The Caye Construction Company of Brooklyn was the general contractor. Steel was fabricated by Ingalls Iron Works Company and was erected for that company by the Benn Contracting Company of Long Island City. Field welding was performed by the Scott Welding Service, Inc., of Long Island City. The writer acted as consultant on design of welded connections and furnished shop and field inspection in cooperation with the state inspectors.

Engineering in Erosion Control

A Brief Survey of Principles and Possibilities in an Expanding Field

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PERHAPS because the structures it requires are simple and small, one is prone to think of erosion control as offering few possibilities for the exercise of engineering talent. Actually, however, it is fast becoming a highly technical field, involving a variety of complex problems in hydrology and soil mechanics. The province of the engineer in erosion control, as distinct from the agronomist or the forester, is outlined here.

TO be fully effective in its physical aspects, any erosion campaign must have the equal cooperation of engineers, agronomists (including soil technologists), and foresters, and must be founded upon a nation-wide willingness to dedicate each parcel of land to that use for which it is best suited by nature, in so far as economic considerations permit. As a prelude to the necessary classification, certain broad distinctions should be kept constantly in the forefront.

In the first place, we are dealing only with that kind of erosion precipitated by acts of man. Such geological phenomena as the current spectacular subsidence of Idaho farms are quite beyond control and are, in the main, beneficial. Secondly, the problems of the arid "dust bowl" are entirely different from those existing in humid regions farther east and along the Pacific coast.

Of the nearly two billion acres of land area in the United States, only a little more than one-fifth is truly tillable, and of this cultivated area almost three-fourths is steep enough to be subject to erosion in some degree. This is the kind of land that usually requires special protection and care in cultivation if erosion losses are to be kept within prescribed limits. For any particular soil, susceptibility to erosion and the difficulty and cost of control during the bare periods of the cropping cycle should determine whether that piece of land should continue to be cropped or should be retired for use as permanent pasture or forest. This means that some sloping fields should be retired, and some should be protected by terracing or strip cropping and contour tillage, while those of more resistant soil on flatter slopes should continue to be farmed as at present.

In regions of sparse rainfall (20 in. a year or less), the problem is mainly one of conserving moisture and curbing the practice of intensive grazing, so as to induce the growth of adequate herbaceous cover. The soil in such regions is normally quite absorptive, and terraces are frequently built on level gradients and closed at the ends, thus forcing all precipitation into the ground.

TWO CATEGORIES OF WORK: RESTORATIVE AND PREVENTIVE

Another distinction of interest to engineers is whether their work is to be restorative or preventive, or a combination of both. The early work of the CCC camps was chiefly restorative; it consisted largely of small-dam construction in gullies on some of the fifty million acres of abandoned farm land made worthless by erosion. Many of these structures were of doubtful feasibility as to cost, but were considered justified by the urgent need to provide work, coupled with the lack of opportunity for adequate preparation. Some of the measures classified as preventive are contour tillage, terracing and terrace-outlet structures, subsoil-chiseling, subsoil-blasting, small-basin construction, contour-furrowing of pastures, and construction of dams to submerge the vertical overfalls at the heads of gullies and thus prevent their further encroachment on good land.

In general, the work in which engineers and foresters cooperate is restorative, while that in which engineers and agronomists cooperate is preventive. According to the late E. R. Jones, of Wisconsin, in his article, "Drop Inlet Soil Saving Dams," in *Agricultural Engineering* for August 1937:

"Erosion control contemplates reduction of the runoff as much as possible by absorption of the rainfall, and the passage of the rest as [surface] runoff to its ultimate destination with as little erosion as possible on the intervening land. The engineer is concerned with both of these phases of control. . . . To reduce runoff, the engineer maps the watershed and delineates for the forester the steep headwater slopes for reforestation. To keep it dispersed, he seeks the help of the soil technologist and the agronomist, and establishes for them the contour lines that are the basis of contour-farming, strip-cropping, and better vegetative covering. To carry it safely after it inevitably concentrates and to induce further absorption, he designs, constructs, and maintains low-gradient terraces across the slope. To let it run down the slope he provides a wide, smooth, tough-sodded run which is the most resistant vegetative covering. But where it has broken the sod and a gully has developed with a vertical overfall at its advancing lip, and where all efforts at resloping and resodding have failed or seem foolhardy, he designs a permanent soil-saving dam. . . .

"Some watersheds have been mutilated so badly and the gully branches have advanced so near to the borders of the watershed that there is not enough agricultural land left to warrant a major structure . . . . There forestry is the best land use and reforestation at a minimum expense is the only remedy.

Light Elevating Grader Especially Designed for Farm Terracing

"In other cases the watershed is small and the vertical drop at the lip of the advancing gully may be only 3 or 4 ft. There, by sloping the vertical overfall to a 10 per cent slope in all directions and sodding it by hand, the sod cover may be reestablished. Vigilance in the detection and repair of broken sod is the price of its mainte-

TYPICAL DROP-INLET CULVERT, VIEWED FROM DOWNSTREAM
The Fill Has Not Been Completed

nance. A single break in a sodded run creates an overfall which starts a washout that may undo the entire treatment. Where both the cost of sloping and the risk of sodding are great, a permanent structure is the economical solution . . . . "

Perhaps the most valuable contribution of engineers to the erosion problem is their habit of thinking in quantitative terms, and their insistence upon designing for specific rainfall frequencies with definite factors of safety. Since the object of engineering treatment is to reduce surface runoff to a minimum and to dispose of what remains in a harmless manner, it is important that all the interrelated factors which influence runoff and erosion losses be clearly understood.

The most concise and clear-cut way to express relationships of this kind is in the form of a "word equation" such as the following:

$$\begin{bmatrix}\text{Erosion loss}\\\text{or runoff}\end{bmatrix} \text{ varies as}$$

$$\begin{bmatrix}\text{Rainfall}\\\text{character-}\\\text{istics}\end{bmatrix}\begin{bmatrix}\text{Steepness}\\\text{and length}\\\text{of ground}\\\text{slope}\end{bmatrix}\begin{bmatrix}\text{Kind and}\\\text{density}\\\text{of vege-}\\\text{tal cover}\end{bmatrix}\begin{bmatrix}\text{Erosive}\\\text{and}\\\text{absorptive}\\\text{properties}\\\text{of the soil}\end{bmatrix} \qquad [1]$$

As a result of continuous records and research, it is now possible to avoid the looseness of generalities. Thus Eq. 1 becomes:

$$\begin{bmatrix}\text{Critical}\\\text{runoff in}\\\text{cubic feet}\\\text{per second}\end{bmatrix} \text{ equals } \begin{bmatrix}\text{A coefficient}\\\text{of impervious-}\\\text{ness (giving}\\\text{runoff in per}\\\text{cent of rain-}\\\text{fall)}\end{bmatrix}\begin{bmatrix}\text{Rainfall}\\\text{intensity}\\\text{in inches}\\\text{per hour}\end{bmatrix}\begin{bmatrix}\text{Watershed}\\\text{area in}\\\text{acres}\end{bmatrix}$$

Since water flowing at the rate of 1 cu ft per sec will amount to a depth of 1 in. over 1 acre in 1 hour (nearly), this is a homogeneous mathematical equation which can be expressed in the familiar symbol form:

$$Q = C\,I\,A \qquad [2]$$

After the critical runoff for a desired frequency period has been determined, it is necessary to design erosion structures with sufficient discharge capacity to equal or exceed such runoff.

EROSION MAY BECOME SERIOUS BEFORE IT IS DETECTED
In This Case It Has Taken the Form of "Bald Spots" (in the Background) Rather Than Gullies

Rainfall characteristics are not subject to control by man, but a study of existing records indicates that they may be classified as follows: (1) Brief, intense downpours of limited extent; and (2) general rains lasting several days, falling at a slow rate, and extending over areas of considerable size. The magnitude and intensity of both types of rain bear a definite relation to their frequency of recurrence, and the average frequency of any rain of a given magnitude and intensity can be established with reasonable accuracy. Since terracing and gully-control projects seldom, if ever, exceed an area of 1,000 acres, the maximum or critical runoff for a given frequency of recurrence will invariably be caused by sharp, intense downpours of short duration.

Intense downpours usually begin at a high rate, which quickly diminishes with the lapse of time. The magnitude or amount of water falling, therefore, cannot be determined until the time of duration is known. In other words, to express I in Eq. 2 quantitatively, it is necessary to know the average rate of fall during a definite duration period.

Critical runoff results from a rain with a duration period equal to the time of concentration of the area being considered. Data on times of concentration for typical erosion areas of "normal" shape and various slopes have been published in tabular form. Where maps are non-existent and it is impracticable to make a topographic survey, times of concentration can be reasonably estimated by walking over the watershed with a hand level or aneroid barometer and pacing distances along the line of travel. (The data thus secured can be utilized in the Manning velocity formula.)

Knowing the time of concentration and the frequency period for which protection is desired, the value of I can be obtained from charts—such as those in the U. S. Department of Agriculture Bulletin 204, which give the amount of water falling in duration periods of various lengths, in storms of various frequencies, for any locality in the United States. Of course, for use in Eq. 2, I must be expressed in inches per hour.

The coefficient of imperviousness is affected by all the variables in Eq. 1, as it is a measure of the percentage of runoff resulting from a given rain. In addition, it is influenced by the elapsed time since the preceding rain, and by evaporation, transpiration from plants, temperature, humidity, frozen ground, and so forth. Also it is greatly affected by size (and shape) of the watershed area, since the larger areas allow more opportunity for percolation, evaporation, and transpiration.

Probably the most important single factor, however, is the absorptive power of the soil. Lysimeter experiments have shown, for instance, that "Shelby loam" can absorb, after saturation, only about 0.1 in. per hr, whereas contiguous "Marshall silt loam" can absorb 0.75 in. per hr for an indefinite period. Considerable

data on the coefficient of imperviousness has also been published.

For water flowing down hillsides, steepness determines the acceleration in velocity, and length of slope determines the accelerating opportunity and also the volume of water that can accumulate. From theoretical considerations with some experimental support, it can be shown that if the land slope is increased four times, the velocity of water flowing over it is about doubled, and the erosive or cutting capacity is increased about four times. The practice of terracing is designed to divide long slopes into small units where neither harmful velocities nor dangerous accumulations are permitted to occur. (Obviously, scientific design of terrace systems requires a considerable knowledge of soil properties.)

DROP-INLET CULVERT—CLOSE-UP OF STILLING WALL AND RISER STACK

It Is Common Current Practice to Flare Inlets on Three Sides to an Opening Twice the Diameter in a Distance Equal to the Diameter (or Side of Square)

Bare soils vary greatly in their power to resist scouring or erosion. This difference is due very largely to inherent natural properties of the soil grains, which can be measured by testing three characteristics, namely: (1) Dispersion ratio, (2) percentage of colloids, (3) moisture equivalent (see "Properties of Soils Which Influence Soil Erosion," by H. E. Middleton, U. S. D. A. Technical Bulletin 178; also U. S. D. A. Technical Bulletin 316 by the same author).

The dispersion ratio can be estimated by shaking up a handful of soil in a jar of water and noting the time required for settlement and for the water to become clear. (See U. S. D. A. Bulletin 178 for precise technique.) The percentage of colloids can be determined by finding the difference in weight of the material when saturated and when dried at 110 C, and dividing the result by 0.298. The moisture equivalent is found by measuring the maximum percentage of moisture a soil can retain in opposition to a force equal to 1,000 times the force of gravity. This test is performed in the centrifuge, which is standard equipment in all soils laboratories.

The relative erodibility of a soil can be expressed by a single index known as the "erosion ratio." It is the product of the dispersion ratio by the moisture equivalent, divided by the percentage of colloids. Typical values of the erosion ratio as determined for two soils—one known to be highly erodible and the other highly resistant—may be cited by way of illustration:

Item	Iredell Loam (Erodible) 5-10 In. Depth	Davison Clay Loam (Resistant) 9-36 In. Depth
Colloid, per cent	15.0	64.8
Moisture equivalent, per cent	18.1	39.3
Dispersion ratio	13.0	6.1
Erosion ratio	15.7	3.7

The foregoing discussion, of course, does not represent the last word on the subject. It does make possible, however, a practical beginning in the use of rational methods for runoff computations with all the superiorities of such methods over rule-of-thumb practices. As time goes on, greater and greater precision will undoubtedly be possible as a result of the elaborate watershed and hydrologic studies now being projected or under way.

Having determined the critical runoff for any set of conditions and any desired frequency period, the next step is to design appropriate structures with discharge capacities to balance. This involves mostly standard procedure by use of weir formulas or the engineer's favorite velocity formula and the equation, $Q = AV$. The only exception to date is the "draft tube" formula developed as a result of model tests at the University of Wisconsin (Bulletin No. 80, University of Wisconsin, Engineering Experiment Station, by L. H. Kessler) and recommended for use in determining discharge capacities of drop-inlet culverts under earth dams or highway fills. It is:

$$Q = A\sqrt{\frac{2gH}{K}}$$

in which Q is the discharge in cubic feet per second; A, the area of conduit in square feet; g, the acceleration of gravity; H, the total head causing flow (usually measured from the water level in the upstream pond to the top of conduit at outlet); and K, the coefficient of losses (including entrance and bend losses, and losses due to friction).

The discharge of the drop-inlet culvert increases rapidly with an increase in head over the lip, until the culvert is flowing full and the "draft tube" effect becomes operative. After that, increments in head cause only minor increases in discharge. This critical head on the lip is determined by the following relationship:

$$H_1 = \left[\frac{Q}{3.5\,(3D + 4t)}\right]^{2/3}$$

in which H_1 is the head on the lip, in feet; Q, the discharge at critical head (that is, the required discharge capacity, from Eq. 2), in cubic feet per second; D, the diameter of conduit (or side of square), in feet; and t, the thickness of riser wall and lip, in feet. (If the inlet is flared on three sides to an opening twice the diameter, in a distance equal to the diameter, the coefficient of D should be changed from 3 to 5.)

Structural design and construction in erosion-control engineering follows conventional procedure after all disruptive forces are analyzed and provided for with normal factors of safety. A special case arises as the result of the partial vacuum formed in the upper part of the riser stacks of drop-inlet culverts. For a 30-ft dam, this will amount to about 900 lb per sq ft of external pressure at the lip, decreasing to zero at about the midpoint of the riser. The other forces acting on the riser are, of course, earth pressures at any point and overturning moments due to unequal loading.

Monolithic concrete is the favored material for drop-inlet culverts, partly because of a traditional (but sometimes erroneous) belief in its permanence. The principal cause of favoring concrete in the CCC program, however, is the large amount of labor required in fashioning forms and placing. If the true cost per year of service life prevailed, and all cost factors were taken into consideration, it seems certain that the choice would many times swing to precast rigid or metal pipe.

Cutting Costs in Concrete Construction

Substantial Savings Can Often Be Effected by Use of High Early Strength Cement, Duplicate Sets of Forms, or Careful Design of Ordinary Portland Cement Mix

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BUILDING jobs that are rushed to completion have one thing in common with jobs where there is no pressure for fast work—in both cases, lowest construction costs result from the best use of time. How time affects frame erection costs, and how savings can readily be estimated in advance, is told here. The principles apply not only to buildings but to all structures on which there is an opportunity to re-use forms.

It is a generally accepted fact that rush work increases building costs, because of overtime, confusion, and lost motion. Yet contractors' cost sheets show that many rush jobs have been completed at little or no extra cost, simply because faster construction schedules produced savings in frame erection which offset the increased costs of subsequent operations.

A number of questions immediately come to mind. Why is it that rush jobs frequently show savings in frame-erection costs? Are similar savings possible on jobs where the contractor has no reason to push the work? Are these economies obtained only on concrete frame structures, or on steel-frame and wall-bearing jobs as well? How can the contractor find out in advance which erection schedule will produce the lowest concreting cost?

Detailed cost studies now make it possible to answer these and related questions. These studies show that the frame is the only part of the building where time can be saved at no extra expense, and often at a substantial saving. Thus six recent jobs, analyzed in detail with the cooperation of the contractors, have shown net savings of from $0.38 to $1.49 a cu yd of concrete, simply because the contractors used erection schedules which produced the lowest over-all cost of time, forms, and cement.

ERECTION TIME ANALYZED

The time required to concrete a building divides itself into three parts: (1) days required to assemble forms and set steel and conduits; (2) days required for placing concrete; (3) time elapsing until concrete is strong enough to permit removal of forms.

The contractor is paid for work in place, so the second, or concreting period is the one that actually produces income. All other days are consumed in getting ready to pour, or in waiting for concrete to become service-strong so that forms can be stripped and reassembled for the next cycle of operations. If time can be saved in the first and third periods, the total amount of income-producing work completed in a week or a month can be increased.

The number of days in the first period—getting ready to pour—is pretty much fixed by job conditions; relatively little time can be saved there. But the length of the third, or strength-gaining period can be increased or decreased, depending upon the type and quantity of cement used in the mix.

For example, a concrete made with 5 gal of water per sack of cement gains strength faster and permits form removal sooner than an 8-gal concrete. Also, a concrete made with high early strength cement hardens rapidly and permits form removal after 1 or 2 days; while ordinary portland cement, which hardens less rapidly, requires 3 to 7 days to attain service strength. Then too, cold concrete hardens slower than warm; and concrete if kept wet after placing gains strength faster than if allowed to dry out.

So this third or strength-gaining period can be greatly reduced or, in fact, eliminated in so far as it affects job progress. Time between pours can be minimized, and output of income-producing work increased, by using a concrete which produces early strength. Similar results can be obtained by using a second set of forms. Which method to use depends upon the value of the time saved as compared with the cost of saving it.

Table I, taken from material just published by the author's company, shows how different strength-gaining periods affect total construction time in buildings of 2 to 8 floors. Forming schedules of 3 to 6 days per floor are shown, with strength-gaining periods of 1 to 7 days. For example, if it takes 5 days to assemble forms and the strength-gaining period is 7 days, the total construction time for 8 floors, working 5 days per week, will be 76 days. With the same 5-day forming schedule but with a 1-day strength gaining period, the 76 days is reduced to 48, saving 28 days. The same number of days can be saved, in this instance, by using 9-day concrete with an extra set of forms.

Then come these questions: How much are 28 days worth? What will it cost to save that much time? Which is cheaper, early-strength concrete, or an extra form set? Answers are readily obtained by comparing the over-all cost of time, forms, and cement. Let us con-

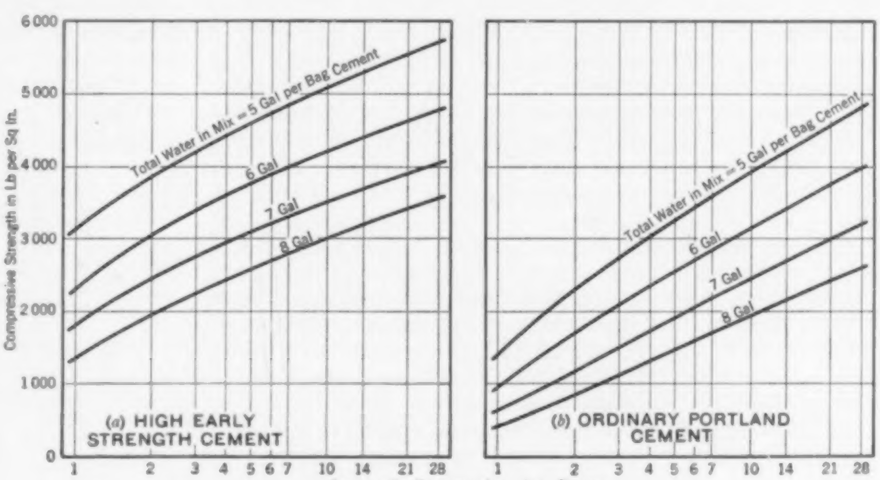

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Fig. 1. Effect of Water Content on Concrete Strengths in First 28 Days
From Tests of 6 by 12-In. Cylinders (A.S.T.M. Specifications) Cured Moist at 70 F.
Tests Made in Research Laboratory of Lone Star Cement Corporation

sider each of these three items in turn.

Time costs are made up of general overhead, job overhead, and equipment charges. General overhead includes the value of the contractor's own time, plus general office expense—rent, light, heat, salaries, and other items. These charges, without counting taxes and insurance, amount to at least \$25 a day, and may run from \$50 to \$100 or more a day. Job overhead is made up of payroll charges and expenses, including superintendent, timekeeper, and watchman; it averages between \$20 and \$30 a day. In some localities, various foremen and skilled workers are also carried on straight time; this may mean as much as \$65 a day more. So job overhead ranges from \$20 to \$100 a day, on buildings of moderate size. And there are, in addition, the job office and other charges, including liability. Equipment costs are also a daily charge against the job, whether the contractor owns the equipment or rents it—and whether the equipment is in use or not.

WINTER CONSTRUCTION ON STEEL-FRAME BUILDING WITH CONCRETE FLOORS

Here are three kinds of overhead costs, the total of which depends upon the time it takes to finish a job.

TABLE I. WORKING DAYS REQUIRED FOR COMPLETION OF CONCRETE FRAME, BASED ON 5-DAY WORK WEEK

Days Required for Forming	Days Before Form Removal	Number of Floors 2	3	4	5	6	7	8	Days Required for Forming	Days Before Form Removal	Number of Floors 2	3	4	5	6	7	8
(a) Using One Set of Forms																	
3	1	8	12	16	20	24	28	32	3	4	9	14	19	24	29	34	39
4	1	10	15	20	25	30	35	40	4	4	11	19	25	31	39	45	51
5	1	12	18	24	30	36	42	48	5	4	15	22	31	40	47	56	65
6	1	14	21	28	35	42	49	56	6	4	17	27	37	47	57	67	77
3	2	9	14	19	24	29	34	39	3	5	10	16	24	30	36	44	50
4	2	10	15	20	25	30	35	40	4	5	12	20	27	35	42	50	57
5	2	13	20	26	33	40	46	53	5	5	16	26	36	46	56	66	76
6	2	15	22	30	37	45	52	60	6	5	17	27	37	47	57	67	77
3	3	9	14	19	24	29	34	39	3	7	12	20	28	36	44	52	60
4	3	10	15	20	25	30	35	40	4	7	14	23	32	41	50	59	68
5	3	14	21	29	36	44	51	59	5	7	16	26	36	46	56	66	76
6	3	16	25	32	41	50	57	66	6	7	18	29	40	51	62	73	84
(b) Using Two Sets of Forms																	
3	7	8	12	16	20	24	28	32	5	9	12	18	24	30	36	42	48
4	10	10	15	20	25	30	35	40	6	10	14	21	28	35	42	49	56

If all these costs are figured (and the contractor pays them, whether he figures them or not), these overhead or time charges usually exceed \$50 a day even on a small job; on a moderate-sized job, they run from \$100 to \$200, and larger jobs are in proportion.

Form costs are made up of material and labor required to build forms; labor required to remove and reerect them; and carpenter work on reshaping and repairs. Forms are made for just one purpose—to hold "wet" concrete, that is, to act as a mold until the concrete hardens sufficiently to retain its shape. Hence the investment in forms is productive only during the first few hours after concrete is placed. Ideally, therefore, forms should be removed the next morning after concreting; the nearer this ideal is approached in practice, the larger the profit earned by an investment in forms. But early form removal depends upon the kind and amount of cement used—which brings us to the third cost factor.

Cement cost depends upon how much cement is used and upon the kind of cement selected. With a small amount of water—say, 5 gal per sack of cement—the concrete has high strength, particularly at early periods; but over 7 bags of cement per cu yd are needed to produce the desired workability. On the other hand, with 8 gal of water per sack of cement, early strengths will be low but only 5 bags of cement per cu yd are needed for workability. Again, there are two types of cement—ordinary portland cement, which gains strength at a moderate rate, and high early strength cement, which produces high strength at early periods but costs more per bag than ordinary portland cement. So the problem comes down to this: What kind of concrete will produce the lowest over-all cost of time, forms, and cement?

FIGURING THE LOW-COST SCHEDULE

A method for finding the lowest over-all cost of time, forms, and cement will now be outlined, using as an example a typical concrete frame structure. The building is assumed to be 80 by 125 ft in plan, and 6 stories (7 floors) in height. There are 1,400 cu yd of concrete in the superstructure, and the mix specifications call for not more than $7^1/_2$ gal of water per sack of cement nor less than 5 bags of cement per cu yd of concrete. Form removal is to be permitted when the concrete has a compressive strength of 2,000 lb per sq in.

The time cost (fixed and job overhead plus equipment charges) is taken as \$100 per day. Ordinary portland

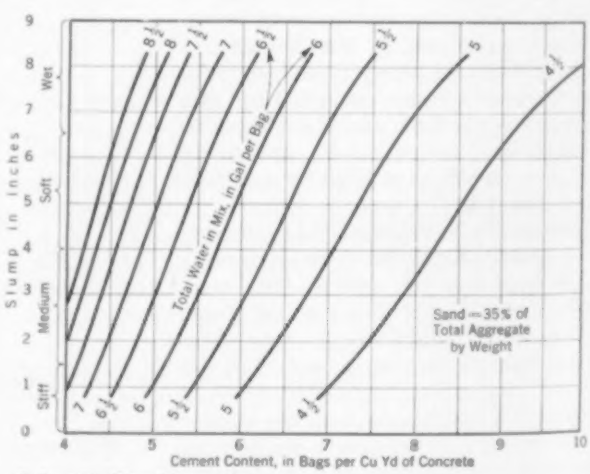

FIG. 2. EFFECT OF WATER CONTENT AND CEMENT CONTENT ON WORKABILITY

cement is assumed to cost \$2.00 per bbl; and high early strength cement, \$2.50 per bbl. The cost of one form set (one floor of forms and two floors of shores) is \$3,700, and the cost of two form sets (two floors of forms and $3^1/_2$ floors of shores) is \$7,100.

The construction schedule is based on a 5-day work week. For each floor it will require 6 days to strip and reassemble forms, place steel and set conduits, and 1 day to pour concrete. The schedule of form removal is to be based on concrete strength. This is not a "rush" job, so the number of days required to erect the frame is up to the contractor.

It will be noted that daily time costs, form assembly, and concreting time are fixed by job conditions; but the length of the strength-gaining period—and hence the time required to erect the frame—can be increased or decreased, depending upon the amount and kind of cement used. A shorter strength-gaining period decreases the time cost but also increases the cement cost, so again we have the question, What cement cost will produce the lowest total cost of time, forms, and cement? There are three steps in the solution:

Table II. Cement Costs for Typical Example

(1) Days for 2,000 Lb per Sq In.	(2) Kind of Cement	(3) Gal Water per Bag of Cement	(4) Bags per Cu Yd	(5) Cement Cost per Cu Yd	(6) Cement Cost for 1,400 Cu Yd
1	High early strength	$6^1/_2$	5.6	\$3.50	\$4,900
2	High early strength	$7^1/_2$	5.0	3.13	4,382
3	Ordinary portland	6	6.2	3.10	4,340
4	Ordinary portland	$6^1/_2$	5.6	2.80	3,920
5	Ordinary portland	$6^3/_4$	5.4	2.70	3,780
6	Ordinary portland	7	5.2	2.60	3,640
7	Ordinary portland	$7^1/_2$	5.0	2.50	3,500

1. Calculation of cement cost. Cement cost varies with the type and quantity of cement used. But both type and quantity depend upon how soon the required strength of 2,000 lb per sq in. is developed. The strength of the concrete is also affected by the quantity of water used; as the water increases, the strength decreases. So it is necessary first to find how much water should be used in order to obtain 2,000-lb concrete at periods ranging from 1 to 7 days.

Figure 1 (*a*) shows that with high early strength cement, 2,000-lb strength is secured at 1 day with $6^1/_2$ gal of water per sack of cement, and at 2 days with $7^1/_2$ gal (the maximum permitted by this specification). Figure 1 (*b*) shows that ordinary portland cement develops 2,000 lb at 3 days using 6 gal, 4 days with $6^1/_2$ gal, and so forth. These values are entered in Table II, Col. 3.

This fixes the amount of water per bag of cement, but the amount of cement in each case will depend upon the desired concrete workability. Let us assume that concrete with a 6-in. slump will have the proper workability, and determine from Fig. 2 the number of bags of cement that should be used with each water content. Thus, using $6^1/_2$ gal of water and 6-in. slump, 5.6 bags of cement per cu yd are needed. Similar data for all the remaining water contents are ascertained and recorded in Table II, Col. 4. (The entry in the last line is determined by the minimum cement content permitted by the specifications.) The computations for Cols. 5 and 6 need no explanation.

2. Calculation of time cost. The next step is to ascertain the effect of these seven strength-gaining periods on the total time required to erect the building frame. The necessary data are taken from Table I and recorded in the second line of Table III. Then, on the third line, is recorded the corresponding time cost at \$100 per day.

Stripping Forms, First Day After Pouring; Popham Hall Apartments

3. Assembly and comparison of cost data. Form costs, from the job data previously given, are now entered in the fourth line of Table III, and cement costs are transferred to the fifth line of that table from Table II.

Finally, the eight columns are totaled and compared.

It will be noted that the total cost of time, forms, and cement decreases (in general) as the time of erection is shortened; the two high early strength cement schedules are cheaper than any of the others. Of course, as the value of time is increased or decreased, other schedules may be more economical. Thus, in this instance, if time costs more than \$180 a day, the erection schedule with one-day form removal becomes cheapest. On the other hand, if time is worth only \$45 a day, the 6-day form-removal schedule is cheapest.

When Mix Is Specified

The foregoing example assumes a specification permitting the design of the concrete mix, so that maximum economy can be secured in both time and cement costs. Frequently, however, it is not possible to design the concrete, because proportions are already fixed by specification.

Take a job where a mix is specified that establishes the cement content at 5.4 bags per cu yd (the usual 1:2:4 mix); in all other respects, conditions are the same as in the previous example. With cement content fixed, it is necessary to find the amount of water per bag of cement that will produce a 6-in. slump concrete; and then determine the effect upon the strength-gaining period and upon total time costs.

From Fig. 2 we find that a 5.4-bag mix requires $6^3/_4$ gal of water per bag of cement for a 6-in. slump; from Fig. 1(*a*), that a $6^3/_4$-gal high early strength cement con-

Table III. Comparison of Cost of Various Schedules, Typical Example

Item	One Form Set							Two Form Sets
Form removal, days	1	2	3	4	5	6	7	9
Erection time, days	49	52	57	67	67	67	73	49
Time cost	\$ 4,900	\$ 5,200	\$ 5,700	\$ 6,700	\$ 6,700	\$ 6,700	\$ 7,300	\$ 4,900
Form cost	3,700	3,700	3,700	3,700	3,700	3,700	3,700	7,100
Cement cost	4,900	4,382	4,340	3,920	3,780	3,640	3,500	3,500
Total cost	\$13,500	\$13,282	\$13,740	\$14,320	\$14,180	\$14,040	\$14,500	\$15,500

Table IV. Cost of Alternate Schedules, Typical Example; Cement Content Specified

Item	Ordinary Portland Cement	High Early Strength Cement
Form removal, days	5	1
Erection time, days	67	49
Time cost	\$ 6,700	\$ 4,900
Form cost	3,700	3,700
Cement cost	3,780	4,725
Total cost	\$14,180	\$13,325

crete will develop 1,950 lb in 24 hours; and from Fig. 1 (*b*), that a similar ordinary portland cement concrete will develop 2,000 lb within 5 days. Following through the other computations as before, we obtain the results shown in Table IV. Here again, the erection schedule making the best use of time shows an over-all saving.

TABLE V. JOB DATA FROM SIX RECENT CONTRACTS

Item	Data					
Job number	1	2	3	4	5	6
Type of building	Hospital	Apartment	Apartment	Clinic	Bottling-works	Office
Location	Fulton, Mo.	Columbus, Ohio	Scarsdale, N.Y.	Fulton, Mo.	Washington, D.C.	Boston, Mass.
Contractor (on concrete)	B. D. Simons	R. L. Wirtz	Willcox Const. Co.	B. D. Simons	E. W. Krys	Scully Co.
Type of frame	Concrete skeleton	Concrete skeleton	Concrete skeleton	Brick bearing walls	Steel	Steel
Floors (incl. roof)	6	7	7	4	3	12
Concrete in superstructure (cu yd)	1,070	2,000	2,270	2,160	700	3,120
Form removal, days:						
Ordinary portland cement	10[a]	7	3	10[a]	7	3[b]
High early strength cement	3[a]	1	1	3[a]	1	2[b]
Form cost, per set	$937	$4,200[c]	$6,000[d]	$1,540	$900	$2,500
Time cost, per day	$28.50[e]	$46.50[f]	$167[g]	$37.75[e]	$32.50[h]	$162[e]
Heat protection, per day	..	...	..	..	..	$67.70
Construction schedule, days:						
Work week	6	7	5	6	..	5
Forming	5	7	4	5	..	6
Pouring	1	..	1	1	..	1[i]

[a] Specified. [b] Days of heat protection. [c] Forms for one floor; 2 sets of shores; cost of forms for 2 floors, with 3 sets of shores, $7,000. [d] 50% more forms required (total cost $9,000) with ordinary portland cement to maintain schedule. [e] Job overhead. [f] Subcontractor's overhead only. [g] General overhead, job overhead, and equipment charges. [h] Job overhead and equipment charges. [i] For half a floor; concrete placed 3 days a week.

Comparison with Table III indicates that the cost of a second form set is higher than either the ordinary portland cement or the high early strength cement schedule.

SIX TYPICAL JOBS

How this cost-comparison method has worked out in practice may well be illustrated by case histories of six buildings recently constructed in different parts of the country. These jobs include industrial, business, institutional, and apartment structures—of concrete frame, steel frame, and wall-bearing construction. Facts were supplied by the contractors, and are used with their permission. For convenience, job data for the six buildings are assembled in Table V, and comparative cost summaries for each job are shown in Table VI. With the following comments, these tables should be self-explanatory. (Paragraph numbers and job numbers correspond.)

1. Mr. Simons figured the job for 10-day form removal, with both one and two form sets, and for 3-day form removal, using high early strength cement with one form set. As a result, he used high early strength cement and one form set for all superstructure concrete, saving 30 days, and enabling him to get the frame up before heavy winter weather set in.

2. Mr. Wirtz figured the job three ways, as shown. By working 7 days a week and pouring a floor a week, he got the building enclosed before heavy weather set in, saving heating expense on both concrete and brickwork. He advanced erection time by $1^1/_2$ months, the value of that time to the owner being $10,500; he also saved the general contractor 6 weeks of overhead.

3. On this job, the contractor was working against time; the apartment house had to be ready for occupancy on October 1. The high early strength schedule proved to be both faster and cheaper; work on the frame began June 15, and the roof was poured on August 3.

4. The same kind of savings are possible on wall-bearing jobs, except where it takes longer to run up brickwork than it does to cure concrete, strip and reassemble forms. On this particular job, each floor was formed and poured in 3 sections; after pouring a section, brickwork was run up to the next floor; on each section, 5 days were required to strip and reassemble forms, place steel, and set conduits, and 1 day to pour concrete.

5. This example is introduced to illustrate the savings made possible by speeding up the concreting schedule in steel-frame structures. The construction was a rush job, the additional space being needed in order to expand the mid-summer production of bottled Coca Cola. In this case, 7-day form removal, using one form set, was the cheapest, but had to be ruled out because it took too long.

6. This illustrates the added value of early service-strength concrete in cold weather. The saving in curing time permits summer schedules in mid-winter and reduces heat-protection costs. On this job, concrete work started December 15 and was finished before February 1—better than $1^1/_2$ floors a week. Concrete was run only two floors behind riveting gangs all the way up the building. Finishing operations were quickly and easily performed, despite adverse weather conditions.

Here, then, are six building jobs, fairly representative of the various types of concrete construction, each showing the practical advantages of estimating in advance the erection schedule which produces the lowest over-all cost of time, forms, and cement. Net savings ranging from $0.38 to $1.49 a cu yd of concrete suggest that this method is well worth considering.

TABLE VI. COMPARATIVE COST SUMMARIES OF VARIOUS CONSTRUCTION SCHEDULES FOR BUILDINGS DESCRIBED IN TABLE V

Job Number	Form Removal, Days	Number of Form Sets	Erection Time, Days	Costs: Time	Costs: Forms	Costs: Cement	Costs: Heat Protection	Costs: Total	Net Savings with High Early Strength Cement over Next Cheapest Method: On Job	Net Savings …: Per Cu Yd
1	10	1	78	$2,223	$ 937	$3,120	....	$6,280	....	...
	10	2	41	1,169	1,874	3,120	....	6,163	....	...
	3[a]	1	48	1,368	937	3,280	....	5,585	$ 578	$0.54
2	7	1	100	4,650	4,200	4,200	....	13,050	....	...
	7	2	58	2,700	7,000	4,200	....	13,900	....	...
	1[a]	1	58	2,700	4,200	5,250	....	12,150	900	0.45
3	3		45	7,515	9,000	6,560	....	23,075	....	...
	31[a]		38	6,346	6,000	7,440	....	19,786	3,289	1.45
4	0		79	2,980	1,540	6,521	....	11,041	....	...
	13[a]		49	1,850	1,540	6,825	....	10,215	826	0.38
5	7	2	15	488	1,800	2,100	....	4,388	....	...
	1[a]	1	15	488	900	2,625	....	4,013	375[c]	0.53[c]
	7	1	27	878	900	2,100	....	3,878	....	...
6	3[b]	4	47	7,614	10,000	7,600	$4,874	30,088	....	...
	2[a,b]	3	32	5,184	7,500	9,500	3,250	25,434	4,654	1.49

[a] High early strength cement. [b] Days of heat protection. [c] Cost of 27-day construction schedule cannot be considered as job had to be finished in shorter period.

Geological Survey Studies Surface Waters

Recent Improvements in Equipment Aid in Measuring Stream Flow

By C. G. Paulsen

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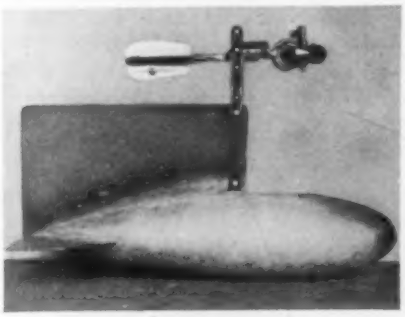
INVESTIGATIONS of water resources had been started in a minor way by the U. S. Geological Survey in 1888, but it was not until 1895 that such work was begun on a systematic basis. To date, stream-flow records indispensable to hydraulic engineers have been collected at more than 7,000 measuring stations in the United States. In recognition of the pressing need for additional records, Congress in recent years has established a policy of matching state and municipal stream-measurement expenditures with federal funds, giving a great impetus to this important activity. In the accompanying article, Mr. Paulsen describes a few of the many new and improved designs for equipment suggested by engineers in the various district offices, as illustrations of the constant progress being made by the Survey in the development of better and more accurate methods. The article is an expansion by the author of his address made during the past year in Memphis, Tenn., at the eighth annual meeting of the Mid-South Section.

A PLENTIFUL supply of water of good quality is one of the most valuable assets of any community, state, or nation, being essential to the activities, health, happiness, and prosperity of modern civilized people. In addition it is one of the most important natural resources of any country, since its availability in liberal quantities is essential to safe and stable development. The adequacy of suitable water supplies controls the maximum size and stability of towns and cities, the development of agriculture, the establishment and maintenance of navigation channels, the operation of power plants (either hydraulic or steam), and the proper placing of industrial plants requiring ample supplies of water of satisfactory quality for use in various processes or for the production of energy. Although such supplies of water are essential for all these purposes, an excess of water beyond normal channel capacities is generally harmful and often disastrous to the regions affected.



Current Meter and 500-Lb Cast-Iron Weight with Steel Vanes for Use on the Lower Mississippi

This Weight Has a Length of 42 In. and a Maximum Diameter of 9.8 In.

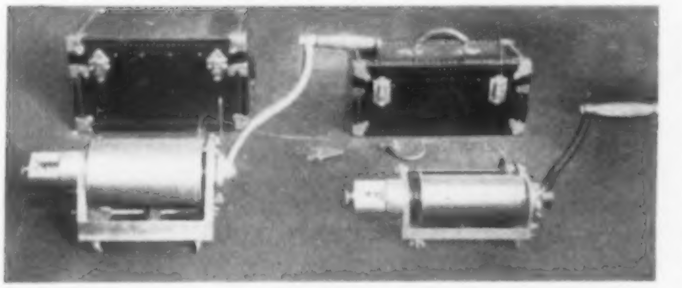
Adequate information on the quantities of water available and the range of stages that may be expected is essential to the design and construction of hydraulic works of all kinds, including structures for flood protection, navigation developments, irrigation systems, municipal supplies, power and industrial plants, drainage of swamp and overflow lands, and the storage of water for various purposes. Such data are also necessary for the establishment of railroad and highway elevations, the design of bridge and culvert openings, and the operation and administration of all structures and developments relating to the use of water.

In the early stages of national growth, the development of agriculture, industry, and commerce—and the resulting growth of towns and cities—took place most rapidly in those regions where water supplies were abundant. As pioneers went westward into the arid and semi-arid regions, it was recognized that water was the limiting factor in development, especially in agricultural and mining enterprises; and in the absence of the records of stream flow needed for planning, many early irrigation projects failed because of inadequate water supplies. As agriculture by irrigation progressed, however, most streams were over-appropriated before it was recognized that an advance knowledge of stream flow must be obtained to safeguard the investments of capital and the rights of individuals. In the humid regions of the East (and elsewhere) the use of water has long since reached the stage where the greatest consideration must be given to the requirements of domestic and industrial water supplies.

Cooperation by States and Municipalities

Because of the general need for reliable and continuous records of stream flow, the river-measurement work of the U. S. Geological Survey has been carried on largely in cooperation with the various states, which over many years have contributed a major part of the funds. In recent years, however, as a result of the growing nationwide need for such information, Congress has established a policy of cooperation with states and municipalities, essentially on a fifty-fifty or dollar-for-dollar basis. Since 1931 the work has been handled largely on this basis, although federal funds have been somewhat smaller than available state and municipal cooperative funds. As an indication of the widespread interest in stream-flow records, 45 of the states, the Territory of Hawaii, and many municipalities are now actively cooperating with the Geological Survey. These agencies are demonstrating their recognition of the value of the work by allotting funds (aggregating more than $800,000 in the fiscal year 1938) for cooperative programs. Such offers by states and municipalities put squarely up to the federal government the furnishing of funds to match them.

The field work of water investigations by the Geological Survey is now conducted through 36 district offices and several suboffices—one in practically every state and one in Hawaii, but all under the general administration of the central office in Washington, D.C. About 3,200 river-measurement stations, of which 2,400 are equipped with water-stage recorders, are maintained and operated by these district offices. Stream-flow records have been collected at more than 7,000 measuring



TYPES OF REELS COMMONLY USED BY THE GEOLOGICAL SURVEY FOR RAISING AND LOWERING CURRENT METERS AND WEIGHTS

stations. These records appear annually in the series of water-supply papers, of which more than 800 have been published and are available for reference, both in the local offices of the Survey and in many public libraries.

The Geological Survey has pioneered in developing methods and technique relating to water-resources investigations. Methods, equipment, and instruments are continually being improved, as a result of the experience of the Survey's trained engineers with the wide variety of streams measured, and many such practices and instruments have been adopted by engineers doing similar work in this and other countries. This development work is still in active progress, as is evident from the large number of new devices that have been put into use recently.

HEAVY WEIGHTS FOR USE WITH CURRENT METERS

One of the more important improvements in recent years is the use of heavy weights for making soundings and for holding the current meter in position when working from bridges, cables, or boats. In previous years relatively light weights had been used, in combination with "stay-line" equipment, for holding the meter in swift currents. The stay-line equipment consists of a secondary cable or wire, spanning the river a short distance above the cable or bridge from which the engineer works, and a line attached to the current-meter cable about a foot above the current meter. This line is carried over a double pulley on the secondary cable and thence to the engineer. The double pulley is designed to traverse the stream on the secondary cable, which should be at such distance upstream from the measuring section that the vertical of the line to the meter will be so small as to eliminate any appreciable uplifting force on the weight. By manipulating the current-meter cable in connection with the stay-line equipment, the engineer is able to make soundings at points approximately vertically below the cable car or railing of the bridge from which he is working.

However, the use of stay-line equipment will not eliminate the necessity for corrections for the curvature in the sounding cable caused by the drag of the water against it, especially if a light weight is used, and this, together with the prospect of obtaining more accurate soundings and the ease of transporting heavy measuring equipment by automobile, have led to the design and adoption of heavy weights. Survey engineers now have a choice of standard weights at 15, 30, 50, 75, 100, 150, 200, and 300 lb each. In addition, 500-lb weights are to be used with power reels and booms at the river-measurement stations on the Mississippi River at Vicksburg, Miss., and Memphis, Tenn.

The use of heavy weights has made necessary the development of reels and booms suitable for handling them from bridges, cables, and boats. Three sizes of these reels, with capacities of 75, 125, and 200 ft of cable, respectively, are now available for field use. Cast aluminum is employed to a large extent in their manufacture in order to make them as light as practicable. Two sizes of reels are provided with brakes, making it possible to lower weights to the bed of the stream without the use of the crank. Each of these reels is equipped with a depth indicator, whereby the depth of soundings can be observed and the position of the current meter known with certainty during velocity observations.

Booms for use with heavy weights are now capable of being folded into such small dimensions as to be easily transportable in light trucks or passenger automobiles, and are adaptable to measuring conditions at a large variety of bridges. One of these folding booms appears in a photograph. A novel feature is an attachment fitted to each boom for indicating the angle made with the vertical by the current-meter cable as it is dragged downstream by the current. If this angle is large, the readings on the indicator are used in determining the vertical depth of the water and the position of the current meter below the water surface.

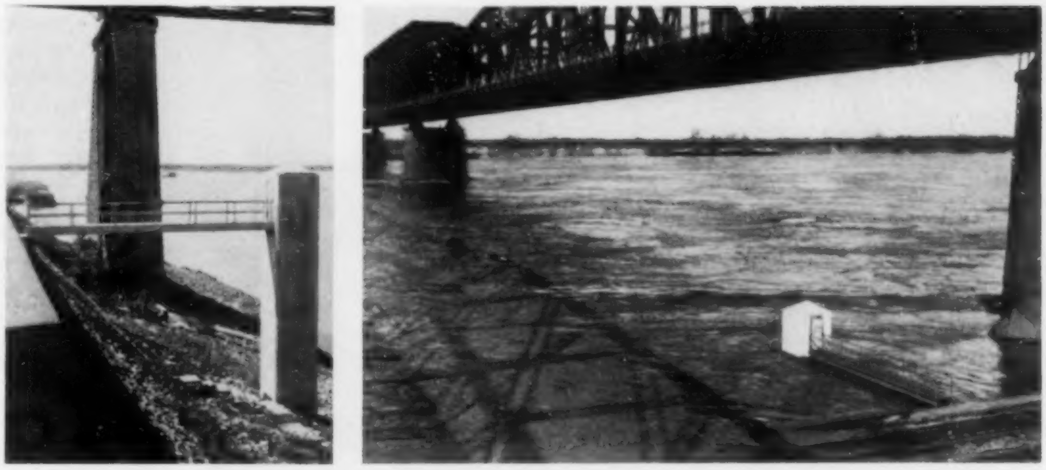
For handling weights heavier than 150 lb, power-driven equipment such as that used at the stations on the Mississippi River at Memphis and Vicksburg is necessary. The reels and booms used at these stations have been attached to automobile chassis. The automobile motors are used to raise and lower the weights. Special equipment, developed for making discharge measurements from small boats, is also used where suitable bridges or cableways are not available. At some stations boat equipment is indispensable for obtaining measurements of discharge over the flood plain. This equipment has been so designed that it can be transported by either passenger car or truck and can be

TYPE "A" BOOM AND REEL COMMONLY USED FOR MEASURING THE FLOW OF STREAMS FROM BRIDGES
This Boom May Be Folded Small Enough to Be Conveniently Transported in a Passenger Automobile

attached to any of the odd-sized rowboats to be found in the vicinity of measuring stations. Some districts have special boats that are moved from station to station on automobile trailers, as needed.

Recently various special attachments have been used in connection with the continuous water-stage recorder. One of these makes a mark on a margin of the chart every 24 hours. This attachment simplifies the corrections of time that occasionally are made necessary by improper adjustment of the rate of travel of the chart or by other causes. Another attachment, operating at the opposite margin of the chart, makes an identifying mark whenever the stylus reverses its direction of motion. This is especially useful in the interpretation

of the record if the stage fluctuates near the point where the stylus reverses its direction of travel. Another recorder attachment that is gaining popularity is a graduated stainless-steel tape used in place of a float cable. Where a tape is so used, it is properly set and adjusted to the position of the stylus. An index pointer, attached to the recorder, indicates the gage height, which is thus read directly from the tape.



RECORDING-GAGE STRUCTURE ON MISSISSIPPI RIVER AT MEMPHIS, TENN.
Left, as the Structure Appeared at Low-Flow Stage; Right, at the Peak of the 1937 Flood

Artificial controls, in the form of low dams having crests sloping towards a notch near the center of the channel, are used in increasing numbers at river-measurement stations on streams with shifting beds. The records on such streams, especially during periods of low flow, cannot be highly accurate unless (1) discharge measurements are made frequently enough to define the shifts in the relation of stage to discharge, or (2) an artificial control is so constructed as to stabilize the stage-discharge relation. In cooperation with the Bureau of Standards, the Geological Survey has recently conducted a series of experiments in the large flume at the National Hydraulic Laboratory to serve as an aid in determining the design of artificial controls that will best produce a satisfactory stage-discharge relation.

At many river-measurement stations, cableways are erected to span the rivers at the most favorable measuring sections nearby. The measuring cable having the longest span in this country was erected in 1936 by the Geological Survey at its station on the Columbia River above the backwater of the Bonneville Dam. This is shown in one of the photographs. It has a span of 1,727 ft and is suspended on steel towers about 110 ft high, on which warning lights are placed to protect air traffic.

STREAM-DISCHARGE INTEGRATOR

Engineers employed on river-measurement work are generally well aware that the discharge corresponding to the average stage on a given day may not be the average discharge for that day, owing to the usual curvilinear relation between stage and discharge. In order to reduce the time required for determining the mean daily discharge from the gage-height graphs produced by a water-stage recorder, a special mechanical computer, called an "integrator," has been developed by the Geological Survey for translating the graphic records of gage height into records of discharge. This integrator, shown in one of the photographs, is fitted with a tracing pointer attached to a ladder which carries a flat metal strip that can be shaped to correspond accurately to the rating curve of any river-measurement station. A planimeter-wheel unit, engaging with this metal strip, revolves on a large rotating disk when the instrument is in operation. After the instrument is properly adjusted, it is placed over the gage-height graph to be translated, and the tracing pointer is made to follow the graph.

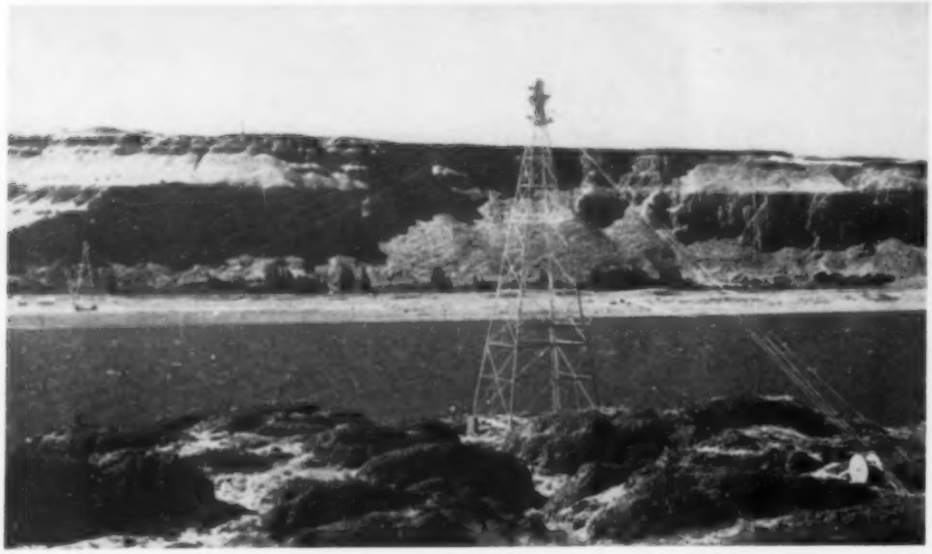
Except for the detail that the integrator measures the fractional part of the mean daily discharge for each infinitesimal part of the day and automatically adds the parts together until the day is covered, the results are similar to those obtained by reading or measuring gage heights from the recorder graph at each hour or other short interval of time, translating them into discharge, and averaging the results to obtain the mean daily discharge.

STUDIES AND EXPERIMENTS NOW UNDER WAY

Experiments are being conducted by the Geological Survey at the National Hydraulic Laboratory, in cooperation with the National Bureau of Standards, regarding the effect of "draw-down" in stilling wells caused by the velocity of flow past the outer ends of intake pipes. Reports are also being made on the results of other experiments at the National Hydraulic Laboratory relating to the accuracy of current-meter measurements made in shallow water.

POWER-DRIVEN EQUIPMENT USED IN MEASURING MISSISSIPPI RIVER FLOW AT MEMPHIS, TENN.

A number of studies of new equipment are being made. Very small current meters of the bucket-wheel type, known as "pygmy" meters, have been constructed and are being tested to determine their value for use in measuring shallow streams. A sounding-reel accessory which embodies a series of springs has been constructed and is being studied with respect to its value in reducing the manual labor needed for raising and lowering heavy sounding weights. A boom with a gasoline motor



CABLEWAY ACROSS THE COLUMBIA RIVER ABOVE BONNEVILLE DAM

This Is the Longest Cableway Used for Stream-Flow Measurements in the United States, Spanning 1,727 Ft Between 110-Ft Towers

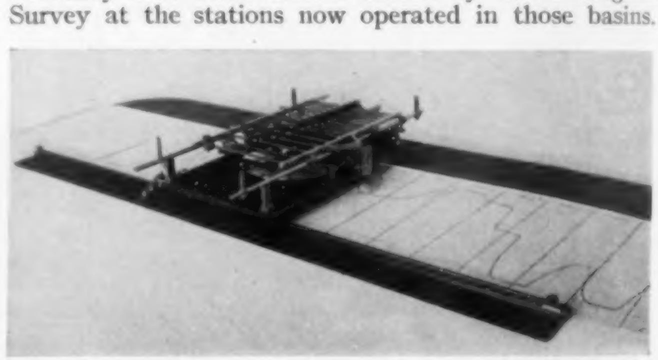
attached has been constructed for similar studies. Trials are being made of a current meter similar to the ordinary Price-type meter, except that the lower bearing is set closer to the center of gravity of the bucket wheel than in the present model. These tests will determine whether the performance is improved by this change.

GROWING NEED FOR WATER DATA

The Federal Administration of Public Works and other federal agencies are extensive users of information collected by the Geological Survey. Such information on surface and ground-water supplies forms the basis for planning, constructing, and operating water projects and for supervising the activities which depend on water. Because of these needs, allocations of public works funds aggregating more than $1,300,000 have been made to the Geological Survey, in addition to regular appropriations, in order that additional information relating to the water resources of the country can be made available for use, in connection not only with present activities but also with future planning. A large part of these funds has been used in improving the facilities for obtaining information concerning surface waters. During the past few years more than 600 of the existing river-measurement stations of the Geological Survey have been rehabilitated and equipped with concrete water-stage-recorder shelter houses, artificial controls, and cableways. About 40 new stations have been established by the use of public works funds in the basins of the Mississippi, Colorado, and Columbia rivers, where records of flow are urgently needed for the successful planning, development, and operation of large undertakings. Many additional stations now operated by the Geological Survey in cooperation with the U. S. Weather Bureau and the U. S. Corps of Engineers have been established, and others in many parts of the country have been reconditioned.

Thus, by cooperation, the same stations serve the needs of the Corps of Engineers in connection with its navigation and flood-control activities, the Weather Bureau in its flood forecasting, and the Geological Survey in obtaining records of daily stage and discharge for public use in connection with all problems relating to water, its control, and its utilization. Other federal agencies cooperate with the Survey in obtaining the stream-flow information needed in connection with their activities.

Studies of flood magnitudes and frequencies for the principal rivers of the country and of rainfall and runoff relations have been made by using public works funds in collaboration with the Mississippi Valley Committee, now the Water Resources Committee of the National Resources Committee. The results of these interesting studies have been published in Water-Supply Papers Nos. 771 and 772. During the past year emergency funds have been made available to the Geological Survey for comprehensive investigations and reports on the record-breaking floods of March 1936 in the northeastern part of the United States. Water-Supply Paper 798 presents many of the facts concerning the New England floods. Similar data for floods in the region between the Hudson and the Susquehanna rivers will be presented in Water-Supply Paper 799, and data on floods in the Potomac, James, and Upper Ohio basins, in Water-Supply Paper 800. A report on the outstanding Texas floods of September 1936 will be published as Water-Supply Paper 816. These studies and reports, compiled by the Survey's district offices, include detailed information of flood flows collected at the many river-measurement stations operated in the flood regions. Similarly, basic stream-flow information relating to the disastrous and record-breaking floods in the Ohio and Mississippi river basins in January and February 1937 have been collected by the Geological Survey at the stations now operated in those basins.



DISCHARGE INTEGRATOR FOR TRANSLATING GRAPHIC RECORDS OF RIVER GAGE HEIGHT INTO RECORDS OF MEAN DAILY DISCHARGE

A report on that flood is in preparation and will also be published as a water-supply paper. Such information is essential to studies and plans for remedial measures in connection with floods.

Recent floods and droughts have served to emphasize the importance and value of stream-flow records. River-measurement stations for continuous operation should be added to the present network of Geological Survey stations at many strategic points. The experience of the past is the only safe guide for the future, and the longer and more adequate the record of stream flow, the more efficiently can plans be made for the use of water and for the occupancy of river channels and flood plains.

The City Plan of Tyler, Texas

Utility Comes First, but Esthetics Are Not Neglected; in Force Seven Years, Its Value Has Been Thoroughly Demonstrated

By O. H. Koch

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A DECADE ago, Tyler, Tex., was a perfect example of haphazard municipal growth. About that time its 17,000 citizens began to realize that if Tyler was to continue as a ranking city of eastern Texas, something would have to be done. The result was a comprehensive municipal plan—which incidentally came into being just in time to be tested by the rapid development that followed the discovery of the East Texas oil field. More recently it has served as a guide to the intelligent selection of PWA and WPA projects. It is of especial interest in demonstrating that planning can be applied helpfully even to relatively small cities. This article summarizes a paper which was recently presented by Mr. Koch before a meeting of the Texas Section.

TYLER, the county seat of Smith County, in eastern Texas, had a population of 17,000 in 1930. It had enjoyed a rapid and healthy commercial development, and its industries included railroad shops and the manufacture of brick, fertilizer, syrup, garments, mattresses, and a number of food products. But Tyler had grown up in hit-or-miss fashion, and the hampering effects of that lack of design were already beginning to be evident. If the city was to continue to grow—and there was every reason to believe that it would—something more than haphazard enlargement was essential. That "something" took the form of an official city plan, prepared in 1930—none too soon to guide the abnormal expansion that occurred following the discovery of the East Texas oil field. The purpose of this article is to outline the principal features of this plan, calling attention to the conditions it was designed to correct, and pointing briefly to some of the results it has already produced.

The plan was based upon the probable needs of the community for a 40 to 50-year period, and was so designed that adjustments could be made to meet changing conditions as the community grew. One of its chief objectives was to help the city officials, in planning for the future, to prepare a program of improvements; and to make it possible to budget the city's physical facilities much in the same manner that its financial program is budgeted.

While it dealt primarily with the area inside the 1930 city limits, its promoters continually kept in mind the fact that the city's development would soon extend far beyond that imaginary line, and general recommendations for the adjoining region within three miles of the city were considered a vital part of the comprehensive scheme.

A MAJOR STREET PLAN TO CURE TRAFFIC ILLS

The most fundamental element of any city plan is the major street plan—for whenever any section of a city becomes so congested that traffic cannot flow evenly and smoothly, then that section will have reached its maximum value and will begin to decline. The framework, or street system, should provide for free and easy movement of people and goods to and from all parts of the city, keeping in mind that the main arteries will be called upon to carry more and more concentrated traffic as the city grows.

In Tyler in 1930, the streets were completely uncoordinated. There was but one street that extended across the city without a jog or a dead end. The streets in general were too narrow; and curiously, most of the few that were of ample width could serve no purpose other than local use either because of dead ends or because within a few blocks they narrowed down to the width of an alley, or ran into offsets of 100 to 150 ft. As in every city, there were certain convenient and favored routes which attracted traffic. However, many of Tyler's least-traveled streets were wider than some of its most congested ones. This condition is, of course, an economic waste.

The plan (Fig. 1) included a system of adequately wide, well-spaced, and well-located streets leading from the central part of the city to the various sections, and on through to the outlying territory, with the most direct

Tyler, Tex., Whose Experience with City Planning Is Recounted in This Article

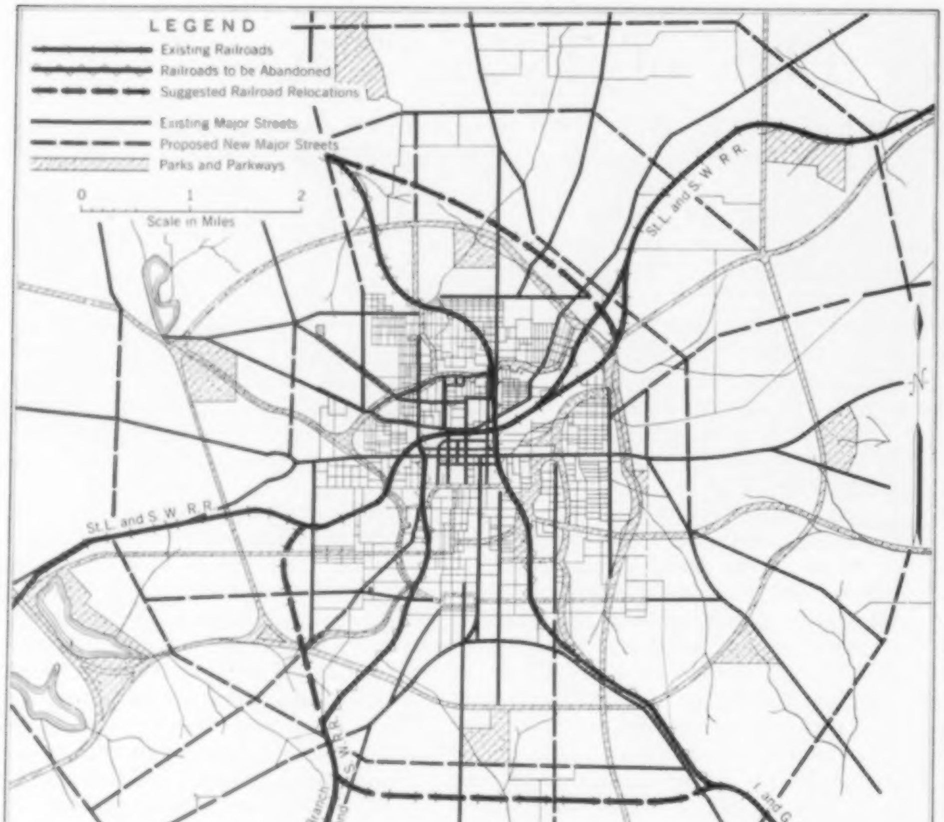


FIG. 1. MAJOR EXISTING AND PROPOSED STREETS AND HIGHWAYS IN THE TYLER REGIONAL PLAN
This Map Also Shows the Existing Railroads and Proposed Relocations

routes, least inconvenience, and fewest hazards possible. It also included belt-line streets, affording direct travel between one section of the city and another, without passage through the central business district. It was recommended that nothing reasonably preventable should be allowed to interfere with the directness of the routes or an adequate width for the main arteries.

This will permit the purely local residential streets to be more economically and efficiently improved. Incidentally, on these narrower roadways the distance between houses on two sides of the street need not be lessened, if a building line is properly established.

The recommended width of streets was intended to be the ultimate width of right-of-way that will probably be required when the communities are built up. In most instances this extra width would not have to be acquired immediately; it would only be necessary to establish a building line to prevent the construction of permanent improvements in this space.

In Tyler the proposed traffic plan followed the principle that the streets should be designed and built for the use they are intended to serve. For local residential streets a minimum width of right-of-way of 50 ft was recommended, with a paving width of 26 ft. However, residential streets longer than 6 or 8 blocks should not be less than 60 ft wide, with a minimum paving width of 36 ft, to provide ample width for two lanes for parallel parking and two lanes for moving traffic. Since such streets are not designed to encourage traffic other than that originating in the immediate neighborhood, the elimination of small jogs or offsets is not important, except in the interests of safety.

The "trafficways" or "boulevards" were the streets with which the major traffic plan was principally concerned. On these roadways the recommended minimum paving width between curbs was 56 ft, and the elimination of jogs and offsets was considered exceedingly desirable. The "boulevards" were intended to be for the use of fast-moving or passenger vehicles. Since 1930, considerable progress has been made in providing the major street system recommended in the plan—including a number of overpasses and underpasses. Several major thoroughfares have been substantially widened, and several new streets have been opened with the recommended width.

COMPREHENSIVE PROGRAM FOR PARKS AND PLAYGROUNDS

The Tyler city plan contains a definite, comprehensive program for parks and playground developments. It is especially important to plan for such things, for in the normal growth of a city natural beauty spots are often carelessly sacrificed to other uses, and their subsequent redemption for recreational purposes is made expensive or even impossible. Incidently, Tyler is unusually fortunate in its picturesque natural topography; the many streams and wooded areas immediately surrounding the city are invaluable assets which few other Texas cities have.

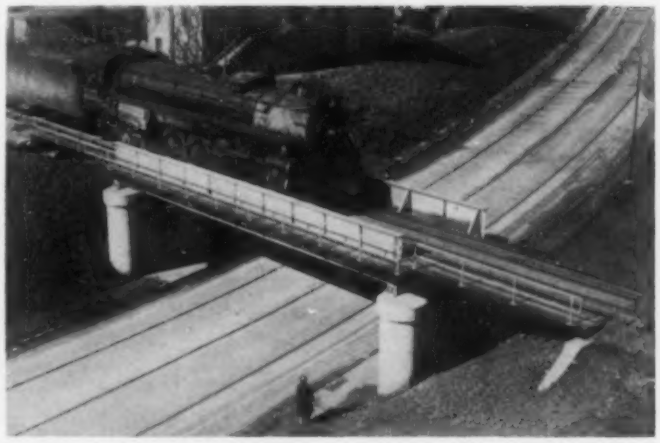
In planning the parks and boulevards, full consideration was given these esthetic advantages. However, the recommendations were based primarily on utility, and only secondarily on esthetics. The parkways are primarily means of transportation; if some of them border on creeks and ravines it is not so much on account of the natural scenery as because of the natural grades available, and the fact that such ground is usually more unsuited for residential purposes. Again, recommendations for beautifying the banks of certain streams were adopted mainly because the stream's capacity for storm-sewer flow could thus be preserved at a minimum cost.

The primary criterion in locating parks and playgrounds was their convenience to serve the inhabitants. For the purpose of the plan three arbitrary classifications as to size and use were adopted for parks.

1. *Playgrounds*. Parks of this type were to be developed primarily for children 6 to 12 years of age. They should contain an area of from 4 to 6 acres each, and should be spaced throughout the city at such intervals that no child would have to walk more than about three-eighths of a mile, or cross railroad tracks or other hazards to get to them. (A practical method of providing this type of park is to extend existing school grounds.)

2. *Playfields*. Playfields should contain from 5 to 10 acres and may be spread considerably further apart than playgrounds. They should be designed for recreation and sports for the larger children. Beautification for both playfields and playgrounds should not interfere with utility.

3. *Neighborhood Parks*. A number of parks comprising from 2 to 15 acres were recommended for develop-



OVER—AND UNDER. GRADE-CROSSING ELIMINATION IS BEING PUSHED ACTIVELY IN TYLER

ment as community centers and recreational areas. They were to be easily accessible and within walking distance of every person in the city—not more than a half mile if possible. The design should reflect in a measure the nature of the surroundings. Construction of automobile driveways through such parks should be discouraged. However, they should be readily accessible from drives and boulevards.

The plan recommended one or more outlying natural parks of some 50 to 200 acres. In addition, it was pointed out that many sites would be available for various desirable recreational uses along the parkways. For example, in several places sharp bends in a stream left small irregular tracts where tennis courts, small playgrounds, or other features could be located.

At the present time four parks have been acquired, and playground equipment has been installed quite generally throughout the city. All recreation in the city parks is supervised. The popularity of the playgrounds has increased each year and the citizens are enthusiastically urging expansion of the program.

The large investment in school buildings and sites makes it difficult to readjust existing facilities; but the plan did concern itself with the spacing and general location of future schools. Care was taken to keep the recommended sites from being located directly adjacent to major traffic lanes, although usually they are not more than one block removed.

One of the most annoying problems of Texas cities today is race segregation. It cannot be solved legally by zoning laws, and the report accordingly recommended the encouragement of voluntary segregation, by providing desirable facilities and conveniences for the negroes in certain distinct areas. This will also make for economy by eliminating the necessity for duplicating schools, parks, and so forth, for whites and negroes in the same areas.

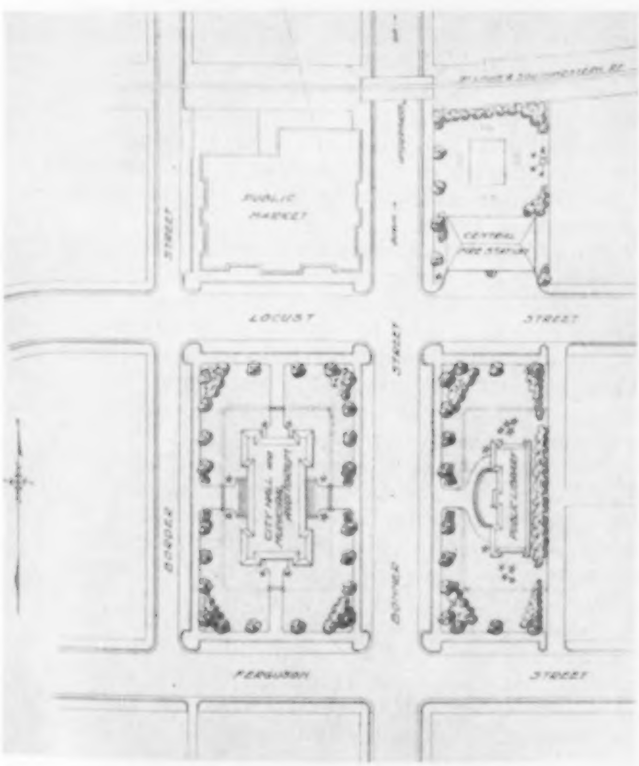


FIG. 2. CIVIC CENTER, AS PROPOSED IN TYLER'S MASTER PLAN

PUBLIC BUILDINGS ALSO PROVIDED FOR

The public buildings of any city may be simply buildings, or they may be structures of a monumental type. And in either case their character is likely to be reflected in the private buildings that are put up around them. With this in mind, considerable attention was given in the plan to the location and design of a "Civic Center" (Fig. 2). A site was selected that could be acquired at a comparatively low price, and the plans made provision for a city hall, a municipal auditorium, a central fire station, a central public library, and a municipal market—to be added successively as conditions might warrant. The site, consisting of approximately four acres, was acquired within six months after the completion of the report. A large frame building on the site was remodeled and is now serving as a temporary city hall. The streets have been opened and paved through the tract, and the remainder of the once unattractive isolated area has been cleared of shacks and beautifully landscaped. It is hoped that the new city hall and the auditorium will soon be erected.

In 1930, Tyler's one fire station was in about the worst possible location. It was impossible to send the trucks south, east, or west without running them through the central business area on streets that were usually congested. And to go north, it was necessary to cross the main-line tracks of the Cotton Belt Railroad over a grade crossing that was frequently blocked with freight trains. As the building housing the equipment had about served its usefulness, it was an opportune time to move the station to a more suitable location, and a recommendation to that effect was made. The plan also

recommended protecting the business district by at least three fire stations, conveniently spaced about its outer edge. This arrangement would also permit trucks from one or another of these stations to serve any adjoining residential district without passing through the business area.

WHEN GOVERNMENT FUNDS WERE MADE AVAILABLE, TYLER KNEW HOW TO USE THEM

The City Hospital, a PWA Project, Is One Step in the Development of a Well-Planned "Municipal Group"

Two sites were immediately purchased and on one a beautiful modern fire station was promptly constructed. The commodious site was adequately landscaped and the improvement was such a contrast to existing conditions in that district that, as a direct result, private property owners have made extensive improvements on their own property and the entire section has been transformed.

RAILROAD RELOCATIONS PROPOSED

One of the most difficult situations affecting the Tyler master plan was the location of the railroad tracks, which crossed the city diagonally in two directions by way of a large number of dangerous and undesirable grade crossings (Fig. 1). On account of the costly improvements then recently completed on the Cotton Belt Railroad's main line through Tyler, it was not considered practical to recommend the relocation of that main line. Five grade-separation structures were definitely recommended along the main line of the Cotton Belt Railway. Three of these have now been completed and the plans are practically completed for the fourth. It will be constructed during the current year, 1938.

A definite recommendation was made for the removal of the Lufkin Branch of the Cotton Belt Railway from its junction with the main line just west of the business district and extending south about three miles through the residential areas, where it would then be carried west to a new connection with the present main line at a point southwest of the city. This has met with favor with the Cotton Belt Railway officials, and plans have been practically completed to carry it out in the near future.

The small amount of traffic on the International and Great Northern Railroad likewise would not justify considering its relocation around the city immediately, though it was pointed out that this project would probably seem more feasible at a later date. Accordingly recommendations were made for a further study and consideration of (1) the relocation of a short section of this line on the north side, (2) a joint track arrangement, using the main line of the Cotton Belt Railroad from the junction through the passenger station into the proposed industrial district, and (3) a reconnection south of the city limits. This would eliminate the grade crossings for some two miles in north Tyler and some three miles in south Tyler, would abandon very few industrial properties on the present I. and G. N. tracks, and would most certainly be of immense material value to Tyler's north and south residential areas. This project, not yet accomplished, is worthy of further serious study.

ZONING REGARDED AS AN ESSENTIAL FEATURE

In the preparation of the master plan, the subject of zoning was regarded as one of the most essential features; public safety and public health, rather than esthetic considerations, were its primary objectives. Several arbitrary classifications were adopted for convenience in designating the specific use—such as business property, residence property, apartments, industrial, and manufacturing. Studies were made to determine the percentage of various types of property-use, to insure that the allocations to the several uses would be in reasonable balance. Control of the heights of buildings, setback distances from property lines, and other similar features, were also investigated.

The final result was a complete, definite set of regulations, which was incorporated in the master plan together with recommendations for a method of procedure to put it into effect. That these zoning regulations have been of tremendous value to the city in the past seven years, especially during the period of the oil boom, can be easily substantiated by contrasting the development and improvement that have taken place in the city of Tyler with those in other similar East Texas oil-field towns where no zoning regulations were in effect.

It was recognized that the proper control of land subdivision for future urban use is of particular importance to prevent many costly corrections in the future. The master plan of Tyler contains a number of land-subdivision rules and regulations, and recommends that the city plan commission require new developers to adhere strictly to the general provisions of the city plan. The integrity of the major traffic and parkway plans should be strictly and zealously guarded, but the developer should be given ample leeway in the detailed development of a project so that there will be opportunity for initiative and individuality. The rules recommended are not arbitrary or discriminatory; they are public information and available to all prospective subdividers or citizens of Tyler.

The subdividers of new additions have cooperated fully in carrying out these recommendations, and Tyler today has a number of sections of parkways and major streets that have been provided and improved by the developers through their properties at no expense to the city. These sections are links of the planned system and can be connected later, at a minimum of expense, to form the continuous units comprising the ultimate system.

The final chapter of the plan report called attention to the fact that the careful preparation of any master plan, and its adoption by the authorities, does not automatically serve as a panacea for all municipal ills. The ultimate value of any city plan lies in the willingness and enthusiasm of the citizens to assist in its proper execution. And this, in turn, requires a considerable amount of educational work on the part of the leaders of the community. In the city of Tyler this phase of the work has been admirably carried on through the publicity department of the chamber of commerce; and there is no doubt but that its work has been responsible for much of the success that has been achieved.

The Use and Trustworthiness of Small-Scale Hydraulic Models

By Paul W. Thompson

Junior American Society of Civil Engineers

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ARE hydraulic model studies worth what they cost? Have they reached the point of diminishing returns? Is there actually any bona fide proof of their reliability? These are questions well worth considering after a decade of intensive use of hydraulic models by American engineers, and Lieutenant Thompson is well qualified by experience and position to suggest the answers. The comments and experiences of other investigators will be welcomed in the discussion columns of this journal.

FOR the past ten years the small-scale model has been used extensively by American hydraulic engineers. Its acceptance as an adequate tool for this work has arisen not only from a faith in what are vaguely called the "laws of similitude," but also from a lack of faith in methods of pure analysis. Many a model study has been undertaken not so much out of confidence that the results obtained would be absolutely accurate, as out of knowledge that the results obtained by ordinary methods very probably would be still more inaccurate. The engineer recommending a model study is making the best of a bad situation; he is seeking the most dependable data available under the circumstances.

The thought occurs that for some types of problems at least, the model study may have reached the point of diminishing returns. For example, so many individual model studies have been made of spillways that it is apparent that there must have been considerable duplication of effort, and that further duplication will be involved in model studies of other spillways. For almost any type of spillway, the engineer can now find records of pertinent investigations to guide him in determining the general aspects of the design. Emphasis here is to be placed on the adjective "general"; available information usually will not extend to details, and therein lies the justification for continuing the practice of making model studies for individual spillways. If, in a project costing hundreds of thousands of dollars, a model study indicates so much as a corner in need of rounding or a sill in need of slight displacement, the cost of the study will have been justified. Probably the day will come when model studies will consistently fail to indicate even refinement of details—but that day is not yet at hand.

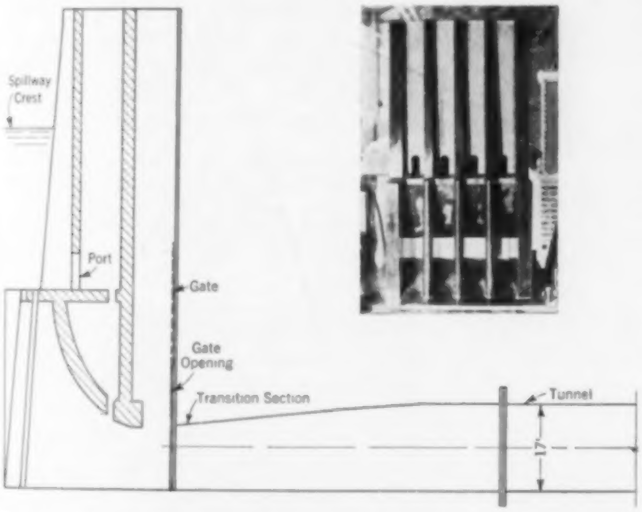


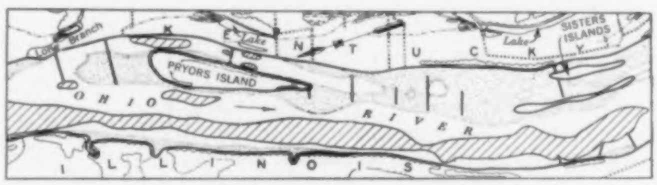
Fig. 1. Section of Sardis Dam Outlet Works as Originally Proposed, and Upstream View of Model

Refinement of Details by Model Study

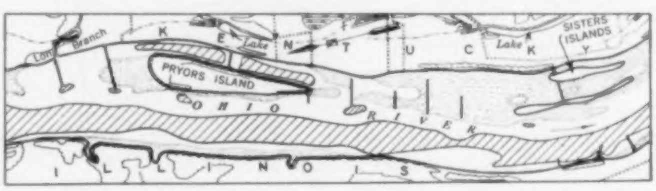
The refinement of details may be illustrated by a model study recently completed at the U. S. Waterways Experiment Station at Vicksburg, Miss. The subject of the study was the outlet works of the Sardis Dam, now under construction on the Little Tallahatchie River, in Mississippi. The design of the works (Fig. 1) was based largely on data obtained from model studies of similar structures, and as was to be expected, the model study resulted in no major changes in the design. However, several refinements of details were indicated. For example, it was found that the ports provided by the original design in the upstream wall of the gate structure operated to increase the turbulence of flow through the gates. By simply eliminating them, the discharge capacity was increased materially. This could not be called a major change in design, but certainly it was a worth-while one.

The accuracy of model data is obviously of transcending importance. Frequently it is remarked that models

(*a*) Survey (1930) to Which Model Bed Was Molded



(*b*) Survey (1936) Which the Model Was Required to Reproduce



(*c*) The Result—Model, Starting with Bed Molded as at (*a*), Developed These Configurations. Compare with (*b*)

Fig. 2. Verification of Pryor's Island Model—Crosshatching Indicates Depths of 9 Ft or More at Normal Pool Stage

of certain types give only qualitative, as distinguished from quantitative, results. However, this convenient statement really begs the question, for the designing engineer must, in his own mind at least, finally arrive at an estimate as to the quantitative significance of the model results.

It is often pointed out that there exist relatively few instances where model results have been verified by subsequent developments in the field. Also, the manifest difficulties inherent in the reproduction, in small-scale models, of such phenomena as turbulence, erosion, and so forth, are emphasized. There is truth in both these allegations; however, it is a mistake to consider the paucity of natural verifications and the difficulties of simulating certain phenomena as having an exclusive cause-and-effect relation. There are several considerations entirely distinct from the difficulties of simulation, which operate to prevent accurate field verification—especially in the case of open river or harbor work, where the works as actually constructed frequently differ in certain respects from those tested in the model. Again, it is invariably true that works as built in the field are subjected to hydrological conditions different from those used on the model. With such factors operating to prevent accurate field verifications of model results, it is not surprising to find such verifications relatively scarce.

MODEL VERIFICATION

Obviously, the points just developed do compromise model results; however, the deficiencies noted are not indications as to the mechanical accuracy of models. If model accuracy is to be measured by the extent to which the model can reproduce events occurring in the prototype, then the reference must be to events that have actually occurred and concerning which dependable records exist. In such case, the experimenter must attempt to reproduce in his model all conditions and forces which affected the prototype during the period in question. If, when he does so, the model faithfully reproduces the event, it can be called accurate. This process stands today as the great guaranty of a model's trustworthiness; it is known at the U. S. Waterways Experiment Station as "model verification."

VERIFICATION OF A FLOOD-CONTROL MODEL

Examples of model verifications are numerous, and one or two typical ones may be of interest. Consider, for instance, the large model of the U. S. Waterways Experiment Station, on which are tested most of the plans having to do with flood control of the lower Mississippi Valley. Verification of this model involved the reproduction of two known events—the floods of 1929 and 1935. To simulate the flood of 1929, the fixed channel was molded to surveys of as near that year as available. Then the flood hydrographs at the respective model inlets (Mississippi, White, Arkansas, Yazoo, Ouachita, Red rivers) were simulated by discharges controlled by manual operation of globe valves and measured over calibrated weirs. The model roughness was then adjusted until the 1929 hydrographs were reproduced, respectively, at all important gages. The flood of 1935 was used simply to check the verification. The check involved remolding the channel to surveys of about 1935 and, without changing materially the roughness, reproducing the flood flows at all model inlets. When hydrographs at all important gages showed satisfactory reproductions, the verification had been checked and the model was assumed to be in correct adjustment. Incidentally, the greatest deviation in flood height at any gage on this check verification was less than 2 ft—that is, 0.02 ft on the model.

A MODEL SO BIG IT CAN BE SEEN IN ITS ENTIRETY ONLY FROM THE AIR

This Model, 1,100 Ft Long, Is Used to Test All Manner of Flood Control Plans for the Lower Mississippi Valley. It Reproduces the River and All Large Backwater Areas from Helena, Ark., to Donaldsonville, La., a Distance of 600 River Miles. It Also Reproduces the Atchafalaya River and Backwater Area from the Source to the Gulf

With the model able to reproduce both the 1929 and 1935 floods, the actual testing of plans proceeded. In this work, the model has proved its value over and over again. Any given set of conditions (such as a system of cutoffs) can be reproduced on it and the desired effects obtained within a matter of days. To obtain similar data by calculation often would take weeks or months.

VERIFICATION OF A NAVIGATION-PROBLEM MODEL

Another type of verification is involved in the case of the "movable bed" model, of which the Pryor's Island model shown in an accompanying photograph may be taken as an example. The essence of the problem at Pryor's Island is in movement of sand and gravel along the river bed. Within the reach represented in the model there are four troublesome "crossings," each of which is subject to shoaling. The verification accordingly involved the quantitative reproduction of the scours and fills known to have occurred in the prototype. In attaining this verification, it was necessary to compromise with several other desirable forms of similitude.

If the experimenter could make materials to order, his problems would be simplified considerably. But he must take what materials he can obtain in reasonable quantities at reasonable prices, and then attempt to compensate for their shortcomings. To simulate the all-important sand and gravel of the natural river bed, he has available various types of sand, various types of coal, various types of rosins, and so forth. Nevertheless, he almost invariably finds himself needing characteristics in his bed materials which are just short of or just beyond the ranges available.

The Pryor's Island model was designed for a bed of coal with a specific gravity of 1.3 and a grain size ranging from 0.25 mm to 2.0 mm. As far as has yet been found,

this coal is the lightest of all materials that are suitable for use in models on other counts. Even so, it is still too heavy; in order to get it to move properly, velocities in the model were certain to be from 10 to 20 per cent greater than their correct scalar values.

In short, what the experimenter does in a case like this is to set himself the task of simulating movement of bed material, be the other consequences what they may. He proceeds in the systematic manner which generally characterizes single-purpose work. He molds the movable bed of his model to accord with some dependable survey, and he sets up another, later, survey as the condition "to shoot for." He subjects his model to the hydrographic conditions which actually obtained in the period between the surveys. Then he proceeds with his cutting and trying. He changes the time scale, emphasizing some stages and minimizing others; he changes the rate of introduction of bed material at the upper end of the model; he manipulates the roughness of the overbank areas; he changes (slightly) water-surface slopes; he changes (very slightly) model bed slopes; he adjusts his method of simulating gravel and rock; he prevents erosions and fills obviously in error; and (as a last resort) he changes the type of bed material. Finally, that happy combination is found whereby the model, with its bed molded to the early survey, reproduces adequately the changes and ends up with its bed approximately in the form of the later survey.

This verification phase of a portion of the Pryor's Island model is summarized in Fig. 2. The accomplishment depicted in those maps represents months of cutting, trying, adjusting, manipulating.

Tests of the Pryor's Island model are still in progress. The general procedure has been to tackle each of the troublesome crossings individually and to develop adequate improvement works. For example, for the crossing opposite Pryor's Island, it has been found that a channel dredged along the island, in conjunction with the raising and lengthening of the dikes downstream, will maintain itself at navigable depths under all conditions likely to occur. (The dike changes are an essential part of this solution.) After the four crossings have been studied

"Overbank Roughness" Is Simulated by Wire Mesh, on Edge
A Close-Up of the Mississippi River Flood-Control Model

independently, the next step is to find which of the solutions will work best when installed together.

COMMENTS

The verification phase of a small-scale model study forms the chief, and in many cases the only, item of evidence as to the model's trustworthiness. The characteristics of the verification—its shortcomings, its theoretical basis, and so forth—accordingly are matters of high importance. Following is a series of comments bearing directly on this point:

1. The application of the verification principle involves induction rather than rigid proof; that is, if a

The Pryor's Island Model Has a Movable Bed Consisting of Light-Weight Coal

model can reproduce what has happened, it seems reasonable to believe that it can show what will happen.

2. Verification with respect to any particular phenomenon requires similarity of the resultant of the forces making up that phenomenon; any individual componential force may or may not be quantitatively simulated.

3. Model verification does not obviate the fact that natural hydrographs, freaks of nature, and other phenomena cannot be predicted.

4. The key to the setting up of equations in hydraulic computations is the determination of roughness-coefficient values; model verification is really the development, by cut-and-try methods, of the correct coefficients. Actual testing of plans on the model is simply the setting up and solving of the equations, coefficients for which have been obtained in the model verification.

5. Model verification presupposes the existence of data from the prototype sufficient to permit development of coefficients.

6. Models of spillways, tunnels, and other structures which, not yet being in existence, obviously have no records, may be verified approximately because the coefficients pertaining to such structures are fairly well known.

7. The same elements that make problems difficult to compute make them difficult to solve by model study; but the shortcomings of the model study often are less grievous than those of computation.

8. Distortion of linear scales introduces problems in verification; it is difficult to make the undistorted spillway model smooth enough; it is difficult to make the distorted river model rough enough; this condition forms the most definite limit that can be set at present for the degree of distortion permissible.

9. Where several phenomena are present in a problem, it generally will be impossible to verify the model with respect to all of them; in such case, the least important phenomena must be neglected.

After examination of the many shortcomings of the small-scale model, one's faith in model results is apt to decline. At such a time one need simply go back to the premise that, with all its shortcomings, the model still is more dependable and accurate in the case of complex hydraulic problems than is the method of pure computation. For all practical purposes, being the best tool available is almost as good as being a perfect tool.

A Typical Divided Highway

Divided Highways Are Safer Highways

Principles in Design of Center Strips and Methods of Separating Existing Roadways

By Roger H. Gilman

Junior American Society of Civil Engineers
Former Research Fellow, Harvard Bureau for Street Traffic Research

HEAD-ON collisions on rural highways have come to be one of the most important problems facing highway and traffic engineers, and others directly concerned with the 40,000 automobile fatalities per year in the United States. Data secured during 1937 from three states and one Canadian province reveal that around 26 per cent of all accidents and 43 per cent of all two-car collisions on rural highways are of this particular type. The hazard truly demands attention; and fortunately, effective remedies for it have already been developed and are finding increasing application.

VARIOUS MEASURES FOR CHANNELIZING TRAFFIC

With the higher speeds and increased registration of automobiles in the 1920's, the hazard of collision between vehicles traveling in opposite directions began to be recognized, and attempts were made to discourage the practice of crossing the center-line. The earliest method and the one in most common use today is the painting of a white line in the middle of the road. The second method is to provide a "dual-type" highway, such as is used extensively in Massachusetts. This type of highway consists of three or four lanes, in which the middle lane or lanes are of a different color and smoothness from the outer lanes, the purpose being to attract drivers to the outside of the road and leave the center for passing only. The usual practice is to construct the outer lanes of light, smooth concrete and the inner lanes either of dark, rough macadam or of black, roughly brushed concrete. Another common method is to install raised markers at regular intervals along the center-line. Among these, the "cat-eye" reflector has been found especially effective at night. Continuous raised markers are also used, but this type is only feasible on four-lane highways, because of the necessity for passing on straight stretches at least. The most popular of the continuous markers is the concrete curb, which may be a flat diagonal, rounded, or perpendicular. A curb about 12 to 18 in. wide, slightly less than vertical, with top and bottom rounded, offers a substitute for actual "dividing" of the highway with a minimum of space.

CERTAINLY anything that promises to reduce the toll of forty thousand deaths taken annually by automobile accidents in the United States should be welcomed by engineers and public alike. In this article Mr. Gilman presents data to show that the use of divided highways will substantially reduce this total by preventing the most deadly type of accident, the head-on collision. He also outlines the basic principles governing the design of center strips, looking towards the attainment of maximum safety and practicability.

SOLUTION OFFERED BY DIVIDED HIGHWAYS

Each of the preceding types has its advantages for special locations, but it is the divided highway that must be looked upon as the permanent cure for the most dangerous of all accidents—the head-on collision. Statistics from the highway departments of Milwaukee County (Wisconsin), Massachusetts, Michigan, Delaware, and New Jersey disclosed that, on an average, divided highways show a 33 per cent reduction in all accidents over comparable undivided four-lane roadways or the same highways before a center strip was installed. The cost of constructing the medial strip (exclusive of right-of-way) amounts to about $18,000 per mile, including curbing, top soil and seeding, and drainage. If any of these three items is omitted, the cost is considerably decreased.

Although almost any center strip will accomplish a separation of roadways, ultimate success will depend to a large extent upon proper design of the strip. Design features include such things as width, curb, drainage, cross-overs, contents of the neutral area, and transitional sections. Of these, the most important is the width of the strip, for that controls cost of construction and maintenance as well as safety. In general, widths fall into four classes. The first, from 4 to 6 ft, sufficient to divide the roadways, is used to some extent by 12 different states, in places where the right-of-way is limited by special location or high cost of land. The second, from 9 to 15 ft, found in 8 states, approximates the width of a driving lane. Third, there is the width of about 20 ft, employed on certain highways by 13 states, which is sufficient to shelter cars that are turning or crossing the road. The fourth class, 30 ft and over, has been utilized by 9 states, mostly in

the Middle and Far West. This width permits a car to turn from the inner lane of one roadway to the inner lane of the other. It also provides for future widening of the highway without necessitating the purchase of additional land, a practice that has been carefully planned and is being systematically carried out by one county highway organization. Furthermore, with a wide distance between directional roadways, there will be better protection for cars, more room for pedestrians, more neutral space for the dissipation of headlight glare, less need for a steep curb, and less strain on drivers who are confused by the proximity of fast-moving vehicles traveling in the opposite direction. It is noteworthy that a number of states are selecting 30 ft as the center-strip width for future highways, and that others using narrower islands flare them out to this width at intersections to facilitate turning and cross-movement.

CURB DESIGN VARIES ACCORDING TO CONDITIONS

The design of the curb should be considered as inseparably related to the width of the medial strip. Where the width of the island does not afford ample protection, the curb will have to serve as a less desirable substitute. In some instances, nothing at all is placed on the edge of the strip, or perhaps only a paint line or bituminous border, as on the German superhighways. But to discourage deliberate or careless driving onto the island, and to provide something for the night driver to "feel" against his tire, some type of raised curb is desirable. The simplest type is nothing more than a slight rise in the pavement, offering little resistance to a vehicle but at least serving as a warning. The diagonal curb is the most popular among the states, being utilized by 16. In a number of cases, this has a base of 9 to 12 in. and a height of 3 in., although it may be steeper, in which case an ogee section is usually adopted. A variation is the "lip" curb, rising vertically about 2 in. and then becoming a flat diagonal to reach its ultimate height. Still another example is the vertical center curb, used in five states, which varies anywhere from 3 to 6 in. in height. No one curb design is suitable under all conditions, and the design chosen will depend primarily on the width of the center strip. On narrow islands, an almost vertical curb will offer better protection to cars traveling in opposite directions. A slight slope from the vertical will preclude any scraping or tearing of the tire wall. As the width of the island increases, the curb may become a flatter diagonal, until at the 30-ft width it is approximately 3 by 12 in. Some curb is needed to insure utilization of the full width of the pavement; on the other hand, a barrier is no longer required, inasmuch as there is space to bring a car to rest should an emergency make it desirable to drive onto the central area. Under all conditions, a white cement curb is to be preferred because of its greater visibility. Some states are now placing panels in the curb to reflect the light from headlights.

At the present time, cross-overs, by which cars may either cross the highway or reverse direction, are usually located at 200- to 500-ft intervals and at all intersections, although a number of states are lengthening this spacing to 1,000 to 3,000 ft, which will concentrate turning movements at a few points and thus minimize exposure. Means of reversing direction every half mile will become more satisfactory as the contiguous land on each side of the road is barred from development and direct access. It is naturally desirable to have grade-separation structures, but in rural areas these will be feasible only at scattered points where a heavy cross-movement warrants. For minor intersecting roads, the question is whether the location of the cross-over should permit direct, or require circuitous travel to slow down entering vehicles. For the latter, a steep curb or guard rail is necessary to prevent deliberate driving across the center strip. For either location of the cross-over, the width of the island should be flared to at least 20 ft to serve as a shelter for a turning or crossing vehicle.

Center Strip Shelters Full Length of the Turning Car
A 20-Ft Width Is Sufficient to Protect Most Cars

The center strip will usually have a surface of grass, although some states use crushed stone or bituminous material. Twenty states use shrubbery to some extent, principally because of its value for screening headlights, on narrow islands in particular. Low shrubbery is used near openings, where full visibility of a turning vehicle is important. When budget or other factors prevent the use of shrubbery along the whole length, an excellent policy is to place it at strategic points on curves where headlights shine directly into the eyes of drivers approaching in the opposite direction. Eventually, low guard rails may be placed in the center of the strips to stop deliberate crossing. Although the medial strip may be used to accommodate light poles on relatively low-speed parkways or roads where the curb is steep, it is no place for such fixed objects on high-speed highways.

When a four-lane undivided highway leads into a divided roadway, a transition to the center island is essential. Both paint lines and reflector buttons have been used with an offsetting to guide the driver around the

A Cross-Over for the Center Island
Drivers Would Be Forced to Slow Down Even More If the Opening Were Further from the Intersection

When the Two-Lane Highway Becomes Overcrowded
This View Illustrates the "Stage Construction" of a Divided Highway. New Two-Lane Pavement on Right

island with room to spare. Beacon lights, arrow signs, and white end-barriers have also been tried in many locations. Undoubtedly the best transition is that in which the neutral area itself is built transitionally to lead

TRANSITIONAL DESIGN FOR A CENTER ISLAND

the motorist automatically into the proper roadway. The flaring of the island will depend upon the speed for which the highway is designed. In any event, the curb in this section should be low.

On side-hill locations and on curves, an increasing tendency is noted to place the two roadways on separate grades. On hills, this effects a saving by reducing the cut required. Another advantage is that the headlights of cars going in different directions will be at different levels.

PRESENT AND FUTURE OF DIVIDED HIGHWAYS

During 1937, a survey was made of the present status of divided highways. Replies received from the highway departments of 47 states as well as numerous other jurisdictions disclosed that by the end of 1937, there were 975 miles of divided highways completed in the state highway systems of this country. Such roads were reported by 28 states—the maximum for a state was 100 miles, and the average was about 35 miles. Of the 28 states, 18 are east of the Mississippi. In addition to states, six county and park jurisdictions have 130 miles completed. Cities have not generally utilized the principle except on boulevards where safety was not the prime factor; exceptions are found in such cities as Providence, R.I.; Radburn, N.J.; and New York, N.Y.

It is impossible to determine at what date the divided highway was adopted for its safety factor rather than for esthetic reasons. However, of the 24 states replying to the question as to when divided highways were first used by their departments, two reported this date as prior to 1921, six were from 1921 to 1930, and 16 as between 1931 and 1937.

In other countries, progress on such roads is reported. The Province of Ontario, Canada, has 40 miles under construction; England has built 120 miles since 1920 with the aid of the Road Fund; and Germany's Reichsautobahnen will amount to more than 5,000 miles when completed.

What of the future for divided highways? Where new four-lane highways are considered justified by traffic volume, the center strip will be an integral part of the design. Two midwestern states plan such construction where traffic amounts to or exceeds about 4,000 vehicles per day, and the 1937 Memorandum of the Ministry of Transport of Great Britain states that where there are or will be "400 vehicles at the peak hour, dual carriageways will be desirable." It is doubtful whether there will be as much construction of three-lane highways as in the past, because of the criticism that has been leveled at this type, and the fact that traffic volume on such a highway would soon require four lanes. Where this type is built, it will be as a stage in the construction of a divided highway.

The problem today is what should be done with present road systems to take advantage of the benefits offered by this new type of design. On certain locations the center strip is especially necessary, as on curves and hills where drivers should not be permitted to cross the center-line and where headlight glare is acute. Other such places include sections where the center piers of overhead structures are in the middle of the road, grade-separation bridges where a turning motorist must be brought into the proper access drive, and regular intersections where shelter should be provided for turning and cross-movement.

When widening of the highway is desired, a number of states are adding two or more lanes, separated from the original lanes by whatever distance is desired for the width of the center strip. Another method, described by the Indiana State Highway Commission, is to add a new lane on each side of an existing two-lane highway, thus producing a dual-type highway, because of the rougher character of the center lanes. When traffic warrants, the original concrete will be torn up and replaced by a sodded center strip, and an outer lane will be added on each side of the second construction. Other

ON CURVES EACH ROADWAY OF A DIVIDED HIGHWAY MAY BE ON A DIFFERENT GRADE

states, regarding the three-lane road as only a stage in the development of the divided roadway, build the middle lane of a low type of construction so that eventually it can be converted into a raised medial strip.

New Jersey has two methods of converting existing highways to the divided type. The first is the widely described method used on the Brunswick Pike, where one of the concrete slabs was moved laterally a distance of 12 ft to permit the construction of a divisional island. Construction of a new lane on the outside of the moved slab completed the job. The second method is to place a precast concrete curb on each side of one of the existing lanes, filling the space between curbs with gravel or other material, and constructing such additional lanes as are necessary to make the road a divided four-lane highway.

As for new two-lane highways, the present trend is to locate them off-center of the right-of-way so that two additional lanes may be added to balance them, when traffic warrants that construction.

New practices will undoubtedly be developed to provide such roads by original construction or conversion. The present mileage of divided highways in this country, the number of states building them, the rapidity with which the design has been adopted in recent years, and the experimentation now being undertaken by highway departments, all point to the gradual elimination of head-on collisions on rural roads.

Esthetic Design of Steel Structures

With Special Application to Suspension, Arch, Lift, and Bascule Bridges

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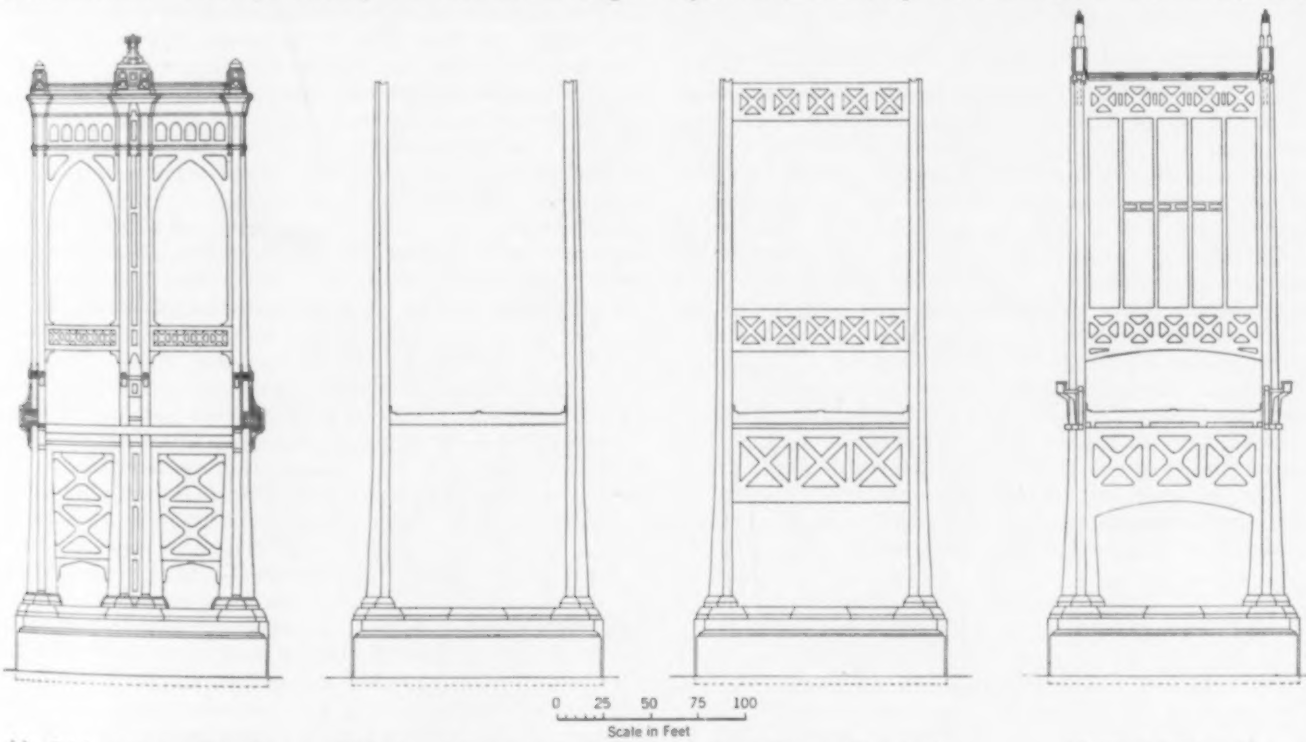
MODERNISTIC design in structural steel, as in other media, is a natural reaction to the undue stressing of ornament characteristic of the Victorian era. But the fetish of a "stream-lined" and "spatial" architecture has also led to some startling aberrations, and the best design for any given purpose lies generally somewhere between these two extremes. Three simple rules are worthy of note: Since the usual sky background reveals steel structures chiefly in silhouette, ornamentation is well-nigh valueless; the use or meaning of every structure should be made comprehensible to the layman; and relations between structural members and enclosed spaces should be agreeable. In the accompanying article Mr. Embury describes in an enlightening way the application of these principles to the design of towers for two suspension bridges; to an arch ring, towers, and bents for an arch span; to a lift bridge; and to a bascule bridge. Readers may wish to refer to two preceding articles on other phases of esthetic design, published in "Civil Engineering" for January and February 1938. Acknowledgment is made to Frank J. Reynolds, assistant architect, the Port of New York Authority, for assistance in connection with the illustrations.

ESTHETIC considerations were never completely neglected by designers of steel structures even in the days when county bridges were being built over every brook by fly-by-night steel companies whose sole apparent ambition was to get the most money for the fewest pounds of steel that would support a horse and buggy. Many of these cheap little bridges were not without a certain loveliness of their own, perhaps because the draughtsmen felt proportion to a greater extent than they themselves realized, or perhaps because a perfectly honest and logical arrangement of members can never be hopelessly ugly.

The really bad days of steel design came later, when engineers began to be conscious of appearance and added extraneous ornaments derived from traditional architectural forms. Since practically all such forms originated in masonry design, the attempt to translate them into light steel members was completely anachronistic. This type of ornament was usually executed by treating steel as a plastic material, and consisted of curlicues, spindles, whorls, and curved members. These were not natural steel forms and their value was further reduced by the fact that they were made as light as possible to keep down costs. Ornament was considered merely as a sop to public taste.

Bridges Reflect the Spirit of the Times

Every structure reflects the spirit of its age, and in these bridges we see the spirit of the Victorian period which, beginning with "Strawberry Hill Gothic" overstressed ornament to a greater degree than any other style in the history of the world. The modernistic



(*a*) Original Design Heavily Ornamented — (*b*) Stripped Down to Basic Elements — (*c*) Deep Trusses Emphasize Squatness — (*d*) Final Design Gives Slimmer Effect

Fig. 1. Evolution of Tower Design for Triborough Bridge—See Page 5 for Artist's Rendering of Final Design

movement, in spite of the horrors perpetrated in its name, has likewise reflected the spirit of the time, in engineering design as well as in other fields. Much of the talk about "stream-lining," and "functional" and "spatial" architecture is far from profound, yet there is behind it the sound fundamental principle that structures should be honest expressions of their purpose.

Throughout the ages the mental processes of the designer have always been the same. At first, he scratches on a piece of stone or draws on parchment or paper what he feels to be a satisfactory solution of his problem, and then (if he has to) he rationalizes it. The "why" of his design is, at least during the period of design, an unconscious one, but if it is analyzed, it will be found to be a composite of what he has observed in the work of others, of the way he has been influenced by his own times, and of his personal equation as a designer.

Engineering structures have unquestionably been greatly benefited by the change in spirit of the times, which is today particularly sympathetic towards what we consider engineering as differentiated from architecture. In the design of the structures with which I have been associated, I have recognized certain elements which are fundamental to the esthetic success of exposed steel construction. While I do not for a moment pretend that they have not been recognized by others, I know of no record of their discovery. These elements are:

1. The silhouette is the first essential. Engineering structures are almost always seen against a sky background which makes ornament valueless.
2. The use or meaning of the structure must be comprehensible to the layman.
3. The relations between the structural members and the spaces which they enclose must be agreeable.

To illustrate these points I propose to discuss the esthetic, or as engineers choose to call it, the architectural reasons for the designs of several structures with which I have been associated, not because I think them the best of their kind, but because I know the reasons for the particular designs adopted.

DESIGNING TOWERS FOR THE TRIBOROUGH BRIDGE

Consider first the towers of the Triborough Bridge, in the design of which I was associated with Allston Dana, M. Am. Soc. C.E., engineer of design. These towers had already been designed as indicated in Fig. 1(*a*) when the bridge was turned over to O. H. Ammann, M. Am. Soc. C.E., chief engineer of the Triborough Bridge Authority, to be redesigned in a more economical and practical manner. Certain limiting factors were forced upon us at the beginning—the heights of the towers to the cables, the clearance of the bridge above the water (fixing the height of the roadway where it enters the towers), the width of the roadway, and the stone bases of the towers (limiting the lateral diameter of the towers). A sketch showing these conditions appears in Fig. 1(*b*). From this it is apparent that the towers are too low and the space from the roadway to their tops is unpleasantly wide for its height. The legs of the towers were placed too far apart for the best transference of wind loads from one leg to another, and comparatively deep trusses were accordingly necessary to tie them together, both at the portal of the roadway and at the top. When the connecting trusses were drawn in, moreover, the bad relation of width to height was sharply accentuated, as shown in Fig. 1(*c*).

Now right here the esthetic consideration comes in—the bridge would have stood up quite as well as it does today had it been built as in Fig. 1(*c*), but it would have been awkward and ungainly, and might even have appeared weak to the general public, because of the slimness of the legs supporting the deep trusses. Furthermore, in this relation of parts there was something fundamentally unpleasing. Our problem was to so arrange the necessary steel, and to so break up the shape as to render it beautiful instead of ugly. One obvious requirement was that the towers should be extended above the top of the cables. Although there was of course no structural reason for doing this, we excused it because the extensions were to be beacon-light standards for aeroplane safety.

There was also the problem of how to treat the ugly space between the portal of the roadway and the bottom of the stiffening truss at the top of the tower. Since it would have been impossible to raise the upper truss without a sacrifice of strength inexcusable from a structural point of view, all our efforts were directed towards securing the lowest portal height that we felt would be acceptable to people driving over the bridge. Of the many sketches made, only two appeared to justify much study. The first of these was an all-over diagonal lattice treatment. The other design, shown in Fig. 1(*d*), was the one finally adopted—because we felt that it most nearly succeeds in disguising the ugly spacing between the towers even though the vertical members inserted there have little or no structural significance.

If we had been able to attack the problem from the beginning, we would have increased the pitch of the cables and thereby raised the towers to a point where so grave an esthetic difficulty would not have arisen. The difference in cost between this bridge and one with higher towers is not easily calculated but it certainly would not be very great and might even be in favor of the higher towers. This is the sort of thing that the engineer and the architect ought to solve together, the engineer approaching the problem from the structural and cost point of view, and the architect representing the ultimate artistic judgment of the educated public. We followed this procedure very closely in designing the Triborough Bridge. Also, we believe that the result is in keeping with the principles previously enunciated.

Within reasonable economical limits, there is considerable latitude in the widths of steel members. Where we felt that a wide member was more satisfactory esthetically, we used it, and where we felt that curved gusset plates produced a better effect, we used them, with the result that the rather curious triangular spaces between the various members of the trusses form interesting

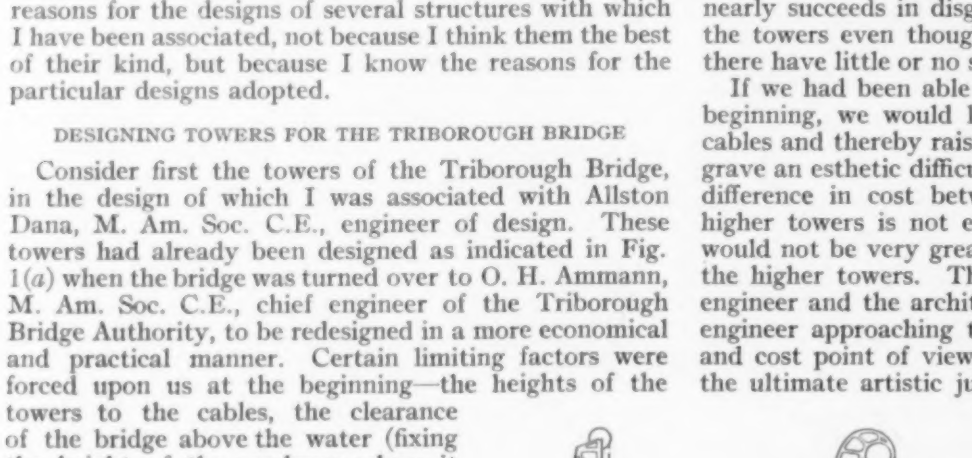


FIG. 2. CONTRASTING TRADITIONAL AND FUNCTIONAL DESIGN OF TOWERS FOR A LIFT BRIDGE
Too Frequently Lift Towers Look Like Up-Ended Parts of Fixed Spans; Design of Towers for the Marine Parkway Bridge, Long Island, N.Y. (at Right) Clarifies Their Function

Fig. 3. Henry Hudson Arch Over Spuyten Duyvil Creek, New York, N.Y., Illustrates Simplicity of Design

patterns. Attention is called in particular to the design of the upper and lower bracing trusses, where the slope of the diagonals was preserved in an interesting way. Even the rivet spacings and their patterns on the plates were studied, especially in the portals over the roadways where they are fairly close to the eye.

A LIFT SPAN—THE MARINE PARKWAY BRIDGE

The second structure to be discussed in this article is the lift span of the Marine Parkway Bridge, of which Messrs. Waddell and Hardesty, Members Am. Soc. C.E., were the engineers. It is indisputable that of all the types of bridges in common use, the lift span is the ugliest. The reasons for this are not difficult to find. A lift span consists of steel posts tall enough to give whatever clearance the government requires when the bridge is up, and strong enough to support the weight of half the span and counterweight (in other words, each tower must be strong enough to support the full weight of the movable span). On top of these towers are great wheels over which the cables go down, on one side to the movable span, and on the other to the counterweight. The natural shape of these elements is peculiar. When the lift span is in the closed position it appears to be fixed, and the functions of these elements are then difficult to comprehend. The lift span therefore violates the second basic element of design, which provides that the method of operation should be apparent. In many lift bridges [as in the typical span in Fig. 2(left)], the design is further confused by the fact that the supporting tower is anchored back to one of the panel points of the side-span trusses in a way which suggests that for some reason part of the truss is turned up on end. This makes it very difficult or impossible for a layman to guess how stresses are transferred through the various members.

In the Marine Parkway Bridge, however, the designers were able to separate the tie supporting the tower legs (the sway bracing of the legs) from the trusses flanking the movable span, and to enclose the counterweight within these limits [Fig. 2(right)]. The unusual design of the side of the towers was adopted in an attempt to indicate how the machinery works. While the face of each tower towards the lift span was kept vertical, the back was inclined in a sort of spiral form, which was continued above the tower proper, curving around the great wheels which support the cables, and enclosing the machinery. In order that the silhouette of the structure might not be confused with those parts extraneous to its function, the counterweights, access ladders, and elevators were painted aluminum and the rest green.

It can be seen in Fig. 2(right) that the various panels are of approximately similar proportions, although of unequal size; that the slope of all diagonal bracing is the same; and that there is a carefully studied relation between the sizes of the legs supporting the towers, their sway bracing, and the members tying the two together.

DESIGN OF HENRY HUDSON ARCH RING

The third bridge which will illustrate our principles is the Henry Hudson Bridge (Fig. 3), a single arch carrying a deck span over Spuyten Duyvil Creek. Robinson and Steinman, Members Am. Soc. C.E., were the engineers. It is hard to make an arch span really unattractive because the circle, of all the natural forms, is esthetically the most satisfying, and there is no way that an architect can "improve" it. The design of a bridge in which an arch span is the principal feature is therefore confined to the disposition of the struts supporting the upper deck, the depth of the arch ring, the treatment of the deck itself, and (most important of all) the design of the approach viaduct and the transition from one type of support resting on solid earth, to another resting on the arch ring.

In this case, as in all others, there were a number of limiting factors: First, the length of the span was determined by the property available; and second, the clearance was as usual fixed by the U. S. War Department.

Design studies were made with the arch ring in the form of a latticed truss with a slightly greater depth at the abutments than at the center, but for the sake of greater simplicity of line, the plate-girder design was preferred, and was adopted as soon as its feasibility and economy were established. The depth of the plate-girder arch ring, $12^1/_2$ ft (the maximum width of large plates obtainable without prohibitive extras), was fixed by the limitations of both manufacturers and transportation. All this depth was needed, both structurally and esthetically, for a span of this length.

The design of the deck span was based on two fundamental considerations: First, that it would support an upper deck when traffic demanded it (this time has already come); and second, that it should be the most economical construction within the lines thus fixed. Since there was to be an upper deck, the usual bracketing of sidewalk and guard rails from the main deck girders was impossible. These girders were therefore placed almost flush with the bents supporting them, so that they themselves form part of the bridge railing, making a sort of through span which is very satisfactory from the standpoints of both economy and ease in construction. The architect was permitted to fix the exact depth of these outside girders, since wide latitude existed between their economic limits. Since the bridge is comparatively high and narrow, it was essential that the type of design adopted should give sufficient width of bent

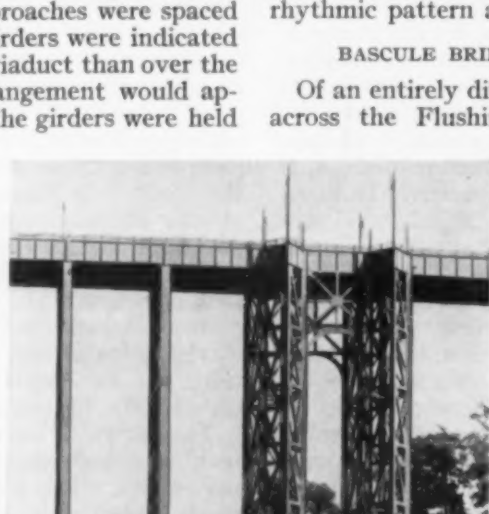
FIG. 4. USE OF DIAGONAL LINES EMPHASIZES PRINCIPLE OF OPERATION OF BASCULE BRIDGE
Bascule Span Across the Flushing River, Long Island, N.Y.

for adequate wind bracing, and this was provided for.

From the esthetic point of view, however, the fundamental elements of the design were the transition from arch span to viaduct and the spacing of the supports in each part. The upper deck is to be supported on steel columns resting on the lower deck girder, and equal rhythm in these spaces was felt to be absolutely essential from the esthetic point of view. Obviously, since these columns could not well be spaced irregularly in relation to the bents, it became necessary to have a simple mathematical ratio between the spacing of the bents on the bridge and those on the approaches, in order that the columns supporting the upper deck might be uniformly spaced throughout. It was found that an economical structure could be erected with the approach bents spaced at almost any distance from 50 to 80 ft while for the water span any spacing from 20 to 35 ft was possible. A unit of 30 ft was therefore adopted for the water span, and one of 60 ft for the land spans, while the upper-deck columns on the approaches were spaced 30 ft apart. Structurally, deeper girders were indicated from the towers to the ends of the viaduct than over the bridge itself, but since such an arrangement would appear awkward and displeasing, all the girders were held to the same depth, the land girders being naturally much heavier.

HENRY HUDSON TOWERS AND BENTS

This disparity in spacing between the land and water bents obviously demanded some transitional feature, and this was supplied by the steel towers at the piers. The engineer and the architect have tried to convince themselves that some sort of tower is proper in connection with the expansion joints. There probably is a slight structural reason for the towers, but as a matter of fact, they were built for esthetic reasons. Although masonry towers are generally used in such bridges, steel towers were chosen in this case for two reasons, the governing one being the decision of the client, Robert Moses, sole commissioner of the Henry Hudson Bridge Authority. The secondary reason was that they are more economical. The result is a rather novel solution of the problem.



TOWER AT END OF ARCH, HENRY HUDSON BRIDGE
The Double Tower Motif Helps to Mask the Transition of Supports from Arch Ring to Soil

The first design studies contemplated a single instead of a double tower, but no single tower motif could be found which would adequately mask the transition between the two systems of support. The double tower was therefore adopted as the most satisfactory treatment in steel which the designers were able to discover.

The relation of the members to the spaces between them was very carefully studied. Since the curve of the arch ring caused the bents to vary in height, a uniform breadth for the members forming the bents proved esthetically unsatisfactory. Their widths were accordingly made to vary from 36 to 15 in., in proportion to their lengths. Similarly, the bents on the approach viaducts decreased in breadth as they decreased in height. For esthetic reasons, the thickness of the bents of the approach span was made greater than was structurally necessary—great enough, in fact, to make the problem of bending due to expansion more difficult than usual. The engineers, however, found a way to take care of this expansion which was structurally sound and not uneconomical, and at the same time preserved the desired esthetic proportions. One other factor often neglected was very carefully studied—that is, the arrangement of the X-bracing between the legs of the bents. Instead of using rolled sections (which perhaps would have been more economical), small lattice girders were used, so as to indicate very clearly the difference in function between the vertical struts and the bracing members. In the disposition of the bracing, a unit was adopted that could be repeated three times on the longest leg, two and a half times on the next, and so on, the angles of the diagonals being kept uniform throughout. The lower side of a bridge of this height is seen from both land and water to a much greater degree than is generally supposed; however, little thought is usually given to the appearance of the soffit. In this case the engineers used a system of K-bracing which forms a beautiful rhythmic pattern as seen from below.

BASCULE BRIDGE OVER THE FLUSHING RIVER

Of an entirely different character is the bascule bridge across the Flushing River, for which Waddell and Hardesty, Members Am. Soc. C.E., are the engineers. While the principle of a bascule bridge was of course familiar to the architect, the interesting and complicated arrangement of its mechanism was completely new. There is perhaps no reason to quarrel with the esthetic effect of a span so well designed, even though it is, as it were, sawn in the middle and weighted at each end so that it will tip. However, the architect felt strongly that the design should express a sense of movement by suggesting in its exterior the wheels and cogs which operate it.

In an attempt to express this movement, a number of drawings were made, based on a circular form at the trunnion with the supporting girder of the bascule projecting out from it like a wing. None of these attempts proved either practical or beautiful, and the architect did what he should have done at the start. He studied the actualities of the situation, and

discovered that these of themselves led to a result which was esthetically satisfactory to him, and to the engineers completely practical structurally as well as exceedingly economical. In previous bridges of this kind the counterweight at the landward end of the tilting span has been concealed as far as possible. In this bridge it was made an integral part of the design. A single sharp diagonal line, reinforced with further diagonal bracing, was carried from the very end of the counterweight to the center of the bridge (Fig. 4).

In designing a bridge of this kind, it is necessary to provide a girder of considerable size from the steel bent which supports the trunnions to the first pier of the approach span, in order to brace the pier supporting the trunnion. The water end of this girder actually is cut out to support the trunnion itself. Although the design of this girder was not much more economical than some other shape would have been, it was felt that the opposing diagonal lines overlapping at the trunnion not only expressed exactly what happened, but also created an exceedingly interesting combination of surfaces and shapes. It is unfortunate that the operating towers should in part obscure the function of the opposing diagonal lines, but the towers were made as small as possible and approximately circular in plan, so that their function might be understood. Since this bridge has not yet been completed, it is too early to be sure that the desired result has been achieved, but it is hoped that this simple and original method of designing a bascule bridge will be as satisfactory esthetically as it is structurally.

Designing Towers for the Whitestone Bridge

When Robert Moses asked O. H. Ammann, chief engineer of the Triborough Bridge Authority, to make a rough study and estimate of cost for the new Whitestone Bridge, now under construction by the Authority, he presented Mr. Ammann and his associates with one of the most interesting problems that could possibly be offered to engineers and architects. In the first place, the bridge will be third in length in the world, exceeded only by the Golden Gate and George Washington bridges. In the second place, both anchorages and approach spans are in the clear, so that the structure as a whole will be visible to an extent that is true in no other case. Since the conditions at each anchorage are substantially alike, the structure can be almost completely symmetrical. Mr. Ammann indicated his desire for a design of extreme simplicity, in which plate girders would take the place of trusses in stiffening the roadway, in which no lattice bracing would be used (steel webs being substituted), and in which no wind bracing would be required between the legs of the towers near the roadway level, the sole connection being at the top, with the bracing in the form of an arch. The clearance of the span over the water was of course fixed by the War Department; the height of the saddles for the cables above the roadway was set at 300 ft 0 in., and the width of the bridge was determined by traffic requirements as 82 ft 0 in. from center to center of the cables.

These limiting factors were unusual in that they did not constitute a handicap to a free design, but on the contrary were both a guide and a stimulus. The plan adopted for each leg of the tower was a "T" on its side (⊣⊢), the cables resting on the cross bars of the "T's." All the earlier designs had been based on the assumption that these legs were separate towers tied together at the top. As soon, however, as the designers began to think of a tower not as a pair of legs connected at the top, but as a unit with an enormous opening cut out of it,

Fig. 5. Final Design for Whitestone Bridge, Now Under Construction in New York, N.Y.

Uniform Width of Towers and Plain Arched Portals Give an Effect of Extreme Simplicity

and reinforced at the sides by steel buttresses, the problem became easy. The adopted design (Fig. 5) is extremely simple; the width of the tower is uniform throughout its height; and the towers as a whole are battered only in the longitudinal direction of the bridge. The only extraneous feature is the enclosure of the gallery which leads across the portal from one leg to the other, at the top of each tower. It was found that extending the towers above the cables increased the dignity of the structure, and a reasonable excuse could be alleged in the enclosure of the gallery. Only the treatment of the stiffeners, sometimes enclosed and sometimes exposed on the tower above the arch, can be considered decorative; even these are structural.

Certain architects who have seen this design have objected to the arched portal as "sweet" and "unfunctional." Actually a considerably greater depth is needed for riveting the portal bracing to the towers than is necessary or desirable at the center of the portal, and while this transition could be made by means of straight lines, correct distribution of the stresses through the portal bracing calls for a lower chord approximately circular in shape. The true circle was therefore not the result of an architectural whim but was asked for by the engineers. Other forms were studied, but in the opinion of the designers none appeared anything like as satisfactory esthetically.

In the designs here discussed we have applied principles which we feel are sound. We know that there is no argument in matters of taste. But we hope that this serious effort to analyze the relations between the pictorial and the structural elements of design may be useful to other engineers and architects.

SURVEYING and mapping on a national scale has attained high official status in government circles. The present deficiencies are recognized and the principle of country-wide development of mapping has been adopted. Despite this approval, the necessary financial support of Congress lags. For most of his life Dr. Bowie has been immersed in the campaign for better maps. His review of these pressing problems reveals what progress already has been accomplished and the much that remains to be done.

ALL IN THE DAY'S WORK FOR A TRIANGULATION PARTY

Taking Stock of National Mapping

Recent Gains Are Encouraging, But the Needs Are Still Great

By WILLIAM BOWIE

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TRULY remarkable has been the growth of interest in surveying and mapping during the past decade, not only on the part of federal mapping agencies but also by those of states, cities, counties, and private corporations. While in the past slipshod methods of making surveys and maps were tolerated because of their cheapness, today the map user desires a product more adequate for his needs, and for this he is willing to pay the price required.

The federal government is charged by law with making a complete topographic map of the United States; by inference it is also charged with the duty of keeping that map up to date. Although Congress in the so-called Temple Act authorized the completion of the mapping of the country, funds in sufficient amounts have not been appropriated, and little or nothing has been accomplished in carrying out the terms of the Act.

MAP DETAILS TO MEET VARIED NEEDS

An evolution of map use in recent years is developing a different type of topographic map. The standard map for most of our area was on a scale of 1 : 62,500, or approximately an inch to the mile. In some areas the standard map scale was only half as large, or 2 miles to the inch. Today there are many uses, such as those dealing with the land in agriculture and forestation, which require maps on a very much larger scale. This problem can be solved by having the original map sheets made in the field or in the office from aerial photographs on the largest scale required. Then maps on large, small, and intermediate scales can be made to meet the needs of all map users. The cost of issuing editions on these different scales would be small as compared with the benefits.

Agencies of the federal government, notably in the Department of Agriculture, are today making special-purpose maps for their own immediate needs. In nearly all cases these are planimetric maps made from aerial photographs and without contouring. Unfortunately, they cannot be of the greatest usefulness because they frequently lack the horizontal control survey data needed to give them accurate position, distance, direction, and scale. These surveys are well advanced, but much detailed work needs to be done to satisfy makers of planimetric and other maps. It would be well if the Coast and Geodetic Survey could receive funds in sufficient amounts to provide control data for all special-purpose maps being made, not only by the federal government but also by states and counties.

OFFICIAL SENTIMENT IS FAVORABLE

Map sentiment in Congress was indicated by a resolution presented in 1936 by Senator Hayden of Arizona, requesting the Secretary of the Interior to formulate and present to Congress a plan for completing the base topographic map of the country. This resolution was adopted unanimously by the Senate, and in response to it the Secretary of the Interior submitted a plan which was published as Senate Document No. 14, 75th Congress.

This plan called for the expenditure, over a 20-year period, of $100,000,000. While this amount is not sufficient to completely map the unmapped areas, yet it is a long step forward. Had Congress appropriated money in accordance with it, $5,000,000 would have been made available for the fiscal year 1937–1938—$1,000,000, to the Coast and Geodetic Survey for horizontal and vertical control surveys, and $4,000,000 to the U. S. Geological Survey for topographic mapping. Unfortunately, the Hayden-Ickes plan has not been initiated and it is questionable whether the requisite mapping funds will be forthcoming during the 1938 session of Congress.

On December 6, 1937, the President wrote to the chairman of the Federal Board of Surveys and Maps, in acknowledgment of a report which set forth the urgent requirements of federal agencies for maps, in part as follows:

"While the construction items to be included in the 1939 Budget will provide for such surveys and maps as may be necessary to the conduct of the construction work, it seems to me that the adoption of any general mapping program should be deferred pending the enactment by Congress of general legislation for the reorganization of governmental activities."

It would seem from the President's letter that the door for mapping is not closed. One could infer that he is waiting upon pending reorganization legislation before inaugurating a national mapping plan. Whether this means that there will be some form of consolidation

of mapping agencies in the federal government is of course not known except to the President and his immediate advisers. It is not important whether the mapping is done by agencies now existing or by others to be created—the principal consideration is that it should be done.

MANY GROUPS ENDORSE PLANNING

Many articles in the technical press, especially in CIVIL ENGINEERING, have shown what great economies could be effected if the country were covered by adequate topographic maps. Today only about 48 per cent of the country is so covered, and more than half of these maps are out of date or otherwise not up to modern needs. In the past appropriations for topographic maps were very small, and the need for base maps by geologists was great. In consequence, large areas were covered by reconnaissance maps that served their purposes well at the time they were made, but not today. Bare outlines of geological structure will not meet the needs of the scientist nor will generalized contours satisfy the engineer.

Many agencies have endorsed a national mapping plan, including the Society and many of its Local Sections. In spite of this large array of sentiment for a national mapping plan, yet it has not been started. It seems reasonably certain, however, that a mapping plan must be put into effect in the very near future. This will require that those who would be benefited by maps should make their wants known to their representatives in Congress and to government officials. This is not lobbying—it is merely the privilege of informed citizens to tell their government what they should have in order that their many activities may be carried on with some degree of efficiency.

Much of the construction work in the United States by federal, state, city, county, and private agencies has been done without adequate knowledge of the terrain where the projects were located. It is inevitable that without topographic maps, the location, planning, and designing of large-scale engineering projects cannot be done efficiently. This applies especially to highways; hydroelectric projects; pipe lines; telephone, telegraph, and electric power lines; water or sewer systems; and to flood projects. Billions of dollars are spent annually on public and private engineering works. It would seem only common sense to assert that any area in which such works are to be located should be adequately mapped.

If on the many public and private engineering projects the surveying were well done, many valuable stations might be added to the national horizontal and vertical control survey nets. Many thousands of miles of traverse and leveling highways are not monumented, and the survey data obtained cannot be utilized for other classes of public or private work. It costs very little extra to do a good job. It would be economy to have these special surveys made with such accuracy that they would supplement the national mapping plan, and above all, so well monumented that they would be available for other uses.

The officials of the Coast and Geodetic Survey have perfected methods for using triangulation data without recourse to the intricate and rather difficult computations involving geographic positions, that is, longitudes and latitudes. The method designed makes it possible to treat a state or large part of a state as a plane, and to compute x and y coordinates for triangulation stations. Users of such control-survey data do not have to consider the curvature of the earth in field operations or in office computations.

Of course no large curved area can be treated as a plane without some distortion to survey and map data; but by dividing each state into strips not more than 158 miles in length, running north and south or east and west, it has been possible to limit the scale factor to one part in 10,000, or 6 in. per mile. Few surveys for construction or location work require greater accuracy than this. If, however, the engineer wishes to have in his plane-coordinate computations an accuracy comparable with that obtained by geodetic methods, he can of course apply the computed scale factors to the plane coordinate data.

Some engineers and surveyors in private work may feel that government work in national mapping is detrimental to their interests. I am confident, however, that the national mapping plan as contemplated at present would help rather than harm such men. All the people, including property owners, would become more aware of the advantages of maps and surveys if a large program were inaugurated. Owners would wish to have valuable land surveyed in such a way that boundary lines could be definitely recovered at any time and protection secured against possible encroachment.

MAKES IDEAL METHOD OF EXPANDING EMPLOYMENT

Much has been written regarding the desirability of having some new industry absorb unemployed men. Why not initiate a map-making program including cadastral surveys, with a view to putting engineers and their assistants to work? A national mapping program, within a few years after its inauguration, should require an expenditure of from \$12,000,000 to \$15,000,000 per year in order to meet the most urgent needs of map users. Although this sum is small as compared with that used on many other public works, yet it would employ many engineers. In no class of engineering is the percentage requirement for technical men larger.

There is no mystery about surveying and mapping. Methods have been standardized and suitable equipment developed for both field and office work. Only the lack of funds prevents the execution of a national mapping plan. Personnel is not a problem, as was shown by the Coast and Geodetic Survey when, under a very large PWA grant, its forces were augmented some 800 per cent, yet the work was carried on at a lowered unit cost, and at practically no reduction in accuracy, although it was necessary to place young men in charge of large field parties and to train new observers and computers in the delicate technical operations involved. This accomplishment was due to the wide training and good judgment of the older engineers and scientists in field and office, who prepared the specifications and instructions, designed the instruments, trained the observers, and supervised the processing of results.

We are certainly becoming more map and survey conscious, and our engineers, planners, and scientists are requiring more and better maps on which to base plans and studies, and to direct operations. Colleges, too, are beginning to recognize that construction is only one branch of engineering, and that the best of structures may fail if not planned in conformity with essential related survey data. Surveying courses are being placed on higher levels. National engineering and other organizations are taking more interest. It is only logical then to expect—and this is a great advance beyond the hoping stage of a few years ago—that the older surveying and mapping methods which varied so in quality will soon give way to scientifically devised methods, and that future surveys will be engineering products, giving maximum service to planners and builders.

ENGINEERS' NOTEBOOK

From everyday experience engineers gather a store of knowledge on which they depend for growth as individuals and as a profession. This department, designed to contain ingenious suggestions and practical data from engineers both young and old, should prove helpful in the solution of many troublesome problems.

Computing Cylindrical Intersections

By Arthur W. Lambert, Jr.

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SINCE the determination of the intersection curve between two cylinders meeting at an oblique angle is a problem frequently encountered in civil engineering design, the writer presents his method of computing

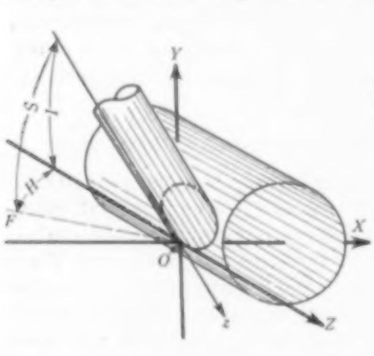

Fig. 1. Principal Axes, Three-Dimensional View

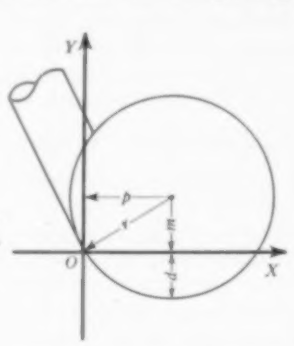

Fig. 2. Section Through Large Cylinder

points on such a curve, devised during the recent design of a proposed dam for Connecticut River flood control. The mathematical method is more convenient and faster than drafting-board development. It also permits greater flexibility in dealing with trial arbitrary values during the initial stages of a design.

We can best introduce the necessary formulas and illustrate their use by solving a definite problem—the opening of a large siphon tube into a diversion tunnel (Figs. 1 to 4). The following nomenclature applies to any two intersecting cylinders of circular cross-section, the numerical values being the constants for the sample computations:

R =	radius of larger cylinder	= 13.00 ft
r =	radius of smaller cylinder	= 1.25 ft
p =	X-coordinate of the center of the larger cylinder	= 11.85 ft
m =	Y-coordinate of the center of the larger cylinder	= 5.35 ft
I =	angle of incidence between cylinders	= 22° 30′
S =	angle of slope of small cylinder	= 9° 03′
H =	horizontal projection of angle I.	

If the problem is stated in terms of the angle H and either of the angles I or S, we must convert it into terms of I and S, since our formulas are to be stated in terms of those two angles. The relation is: $\cos H = \dfrac{\cos I}{\cos S}$.

Rectangular Coordinate System.—Fig. 1 shows the principal rectangular coordinate system adopted. The origin, O, is at the intersection of the lowest element of the smaller cylinder with the wall of the larger cylinder, the latter being considered level. This point, O, is usually set by the choice of an arbitrary value for d (Fig. 2) as an initial condition of the design. Then, $m = R - d$, and $p = \sqrt{R^2 - m^2}$.

Equation of the Larger Cylinder.—Since its axis is parallel to the chosen OZ axis, the equation of the larger cylinder will be simply the equation of its cross-section, a circle (Fig. 2):

$$Y = m \pm \sqrt{R^2 - (X - p)^2} \quad \ldots\ldots\ldots [1]$$

Particular care must be taken to give values of X, Y, Z, m, and p their proper algebraic signs. Equation 1 will give two satisfying values for Y from a mathematical standpoint. However, the value desired will be apparent from an inspection of the case at hand.

Equation of the Smaller Cylinder.—The equation of the smaller cylinder must first be expressed in terms of a secondary or O-xyz system, as shown in Figs. 3 and 4. Both the O-XYZ and O-xyz coordinate systems have the common origin O. In the secondary system, Oz is an element of the smaller cylinder, being its lowest element from a gravitational standpoint; Ox is tangent to the circular cross-section of the smaller cylinder, and Oy is a diameter (produced). Values of x, y, and z are considered positive when measured in the directions indicated by the arrows. The equation of the smaller cylinder in terms of y (Fig. 4) is $y = r \pm \sqrt{r^2 - x^2}$.

Curve of Intersection.—The intersection curve is the locus of simultaneous values of Y and y after the expression for y has been transformed from secondary to primary, or O-XYZ values. The process of obtaining a

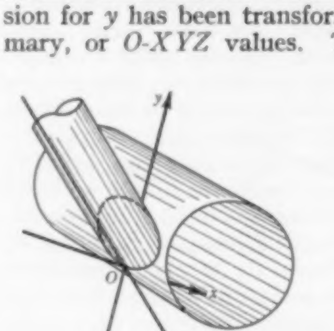

Fig. 3. Secondary Axes, Three-Dimensional View

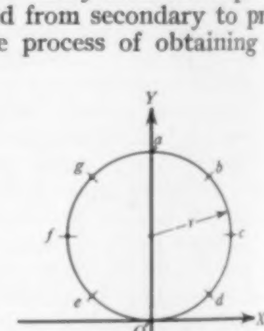

Fig. 4. Section Through Small Cylinder

single expression defining y in terms of X and Z is an extremely involved development, involving fourth powers of dependent variables and numerous radicals from which it is almost impossible to make heads or tails. By making the computations in steps, however, calculations are greatly simplified. The method adopted is to choose arbitrary points on the cross-section of the smaller cylinder, obtain respective x and y values for these points on the secondary system, and substitute these numerical values in the formulas to be given.

As an example, let us take the respective values of x and y for the eight 45-deg points around the circumference (Fig. 4). These values are listed in Table I, where $0.7071 = \cos 45° = \sin 45°$.

TABLE I. SECONDARY COORDINATES

POINT	VALUES OF x	VALUES OF y
a	0	r
b	$0.7071\,r$	$r - 0.7071\,r$
c	r	r
d	$0.7071\,r$	$r - 0.7071\,r$
O	0	0
e	$-0.7071\,r$	$r - 0.7071\,r$
f	$-r$	r
g	$-0.7071\,r$	$r - 0.7071\,r$

For any two circular cylinders, intersecting in space as defined by preceding specifications, the following expression in X must be satisfied:

$$\left[\frac{\sin^2 I}{\cos^2 S - \cos^2 I}\right] X^2 - \left[2p + \left(\frac{2\tan S}{\sqrt{\cos^2 S - \cos^2 I}}\right) y + \left(\frac{2\tan^2 S\cos S\cos I}{\cos^2 S - \cos^2 I}\right) x - \left(\frac{2m\sin S}{\sqrt{\cos^2 S - \cos^2 I}}\right)\right] X + \frac{y^2}{\cos^2 S} + \left(\frac{2\tan S\cos I}{\cos S\sqrt{\cos^2 S - \cos^2 I}}\right) xy + \left(\frac{\tan^2 S\cos^2 I}{\cos^2 S - \cos^2 I}\right) x^2 - \left(\frac{2m\tan S\cos I}{\sqrt{\cos^2 S - \cos^2 I}}\right) x - \left(\frac{2m}{\cos S}\right) y = 0 \quad \ldots\ldots.[2]$$

This is a rather formidable looking equation. However, after substituting the constant values involved for any particular case, it reduces to a much simpler expression. For instance, for the case at hand, it becomes:

$$(1.20)X^2 - (18.87 + 0.38x + 0.91y)X + 0.18x^2 + 0.85xy + 1.03y^2 - 4.51x - 10.83y = 0 \ldots [2a]$$

This expression, Eq. 2a, holds for all computations of X values for points on the curve of intersection involved.

Computations.—To proceed with our example, let us compute the X, Y, and Z coordinates for the intersection of the element f of Fig. 4. From Table I, $x_f = -1.25$ ft, and $y_f = 1.25$ ft. Substituting in Eq. 2a, $1.20\,X_f^2 - 19.54\,X_f - 7.35 = 0$, whence $X_f = 16.65$ ft, or -0.37 ft. Inspection makes it obvious that the value desired is the negative one.

Since the point of intersection lies on the surface of the large cylinder, Y must satisfy Eq. 1. Hence, substituting the given values of m, R, and p, and the particular value of X just computed, $Y_f = -9.79$ ft, or -0.91 ft. From inspection, the desired value is $Y_f = -0.91$ ft.

The formula for determining Z is:

$$Z = \frac{X\cos I - x\cos S}{\sqrt{\cos^2 S - \cos^2 I}} \quad \ldots\ldots\ldots\ldots [3]$$

and for any given case, $\cos I$ and $\cos S$ are constant values. In the present example, Eq. 3 reduces to

$$Z = 2.65X - 2.83x \ldots\ldots\ldots\ldots [3a]$$

To determine Z_f, we substitute the previously determined values for X_f and x_f, whence $Z_f = -2.58$ ft.

Coordinates for the remaining points in Table I can be quickly computed by substituting respective values for x and y in Eqs. 2a, 1, and 3a. Coordinates for any desired intermediate points can likewise be computed.

After sufficient points have been determined, a smooth curve can be drawn in each of the three drawing elevations to give the shape and dimensions of the intersection.

Intersection of the Axis of the Smaller Cylinder.—The secondary coordinates of the axis of the smaller cylinder are seen from Fig. 4 to be $x = 0$, $y = r = 1.25$ ft. Substituting these values for x and y in Eqs. 2a and 3a will give the X and Y coordinates desired, the Y coordinate being found as before. Similarly, the intersection of any line parallel to the axis of the small cylinder can be found by determining its x and y coordinates and substituting these values in the working formulas.

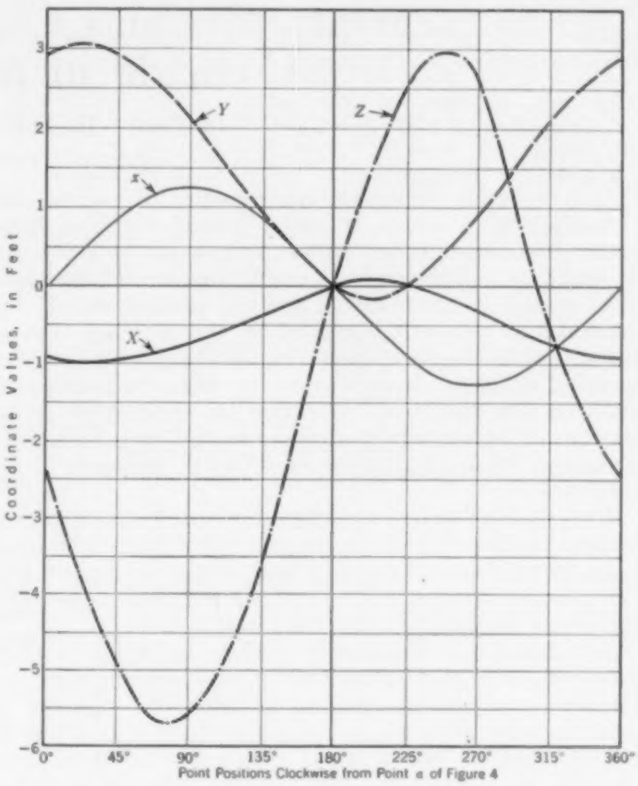

FIG. 5. VALUES OF x, X, Y, AND Z FOR THE DEMONSTRATION PROBLEM

Solution for Intermediate Points by Graph.—If the intersection is comparatively large, such as the junction of two large conduits or tunnels, it may be desirable to know the coordinates of numerous points on the curve. Excessive computation can be avoided by plotting the x, X, Y, and Z values of the eight points at 45-deg intervals, and drawing smooth curves through them (Fig. 5).

Because of the complex nature of the equations, it is impracticable to solve for maximum, minimum, or other critical values by the methods of differential calculus. A very close approximation to these values, however, can be obtained by noting x values on the graph close to these turning points and computing values in this critical region.

It should be noted that, for the particular case illustrated, in a small zone between approximately 180 and 225 deg, the values for X, and consequently Y, change sign in a manner that at first may appear to be the result of an error in computation. Investigation reveals that this change in sign happens because for the particular conditions of this problem, within this zone, the wall of the larger cylinder recedes faster for a time than the rise between successive elements to the left of the origin on the small cylinder. The possibility of this change in sign for X and Y values should therefore always be investigated during preliminary design of any large or important intersection of the type described. It demonstrates the apparently contradictory fact that the lowest element of the intersecting cylinder from a gravitational or drain standpoint may not be actually at the lowest point in the intersection itself.

Neutral Axis and Center of Gravity Do Not Coincide in a Riveted Girder

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THE question regarding the location of the neutral surface in a beam or girder containing rivet holes arose in connection with an experimental investigation in which it was desirable to use a shot-welded stainless-steel model to represent a riveted prototype. If the neutral axis were not displaced by the presence of rivet holes, it would be concluded that the stresses for the gross sections could be derived correctly from measurements made on a welded model, and that the stresses at the net sections of the prototype structure could then be derived by proper theoretical allowances for the presence of the rivet holes.

Experiments made to determine the location of the neutral surface in a simple rectangular beam, containing holes in the lower half only, led to the conclusion that the neutral surface was not displaced to coincide with the center of gravity of the net cross-section.

A transparent beam, subjected to constant bending moment for a part of its length, was examined photoelastically. (Readers unfamiliar with this method of analysis are referred to "Photo-Elasticity—a Short Explanation of the Optical Principles Involved," by Thomas H. Evans, in CIVIL ENGINEERING for October 1933.) The dimensions of the beam and the method of loading are shown in Fig. 1. The beam had zero stress, both direct and shearing, at its neutral surface for the part subjected to constant bending moment. Therefore, for this part of the beam, the principal stresses at a point on the neutral surface remained zero during an increase in the load, and consequently their difference remained zero. It follows that to determine the position of the true neutral surface photoelastically, it was sufficient to find the point at which the fringe order did not change as the load was applied or increased.

In beginning the test, a small initial load was applied to the model and the resulting fringe pattern was photographed. This initial fringe pattern was designated as fringe pattern I. One of the fringes, located near the mid-depth of the beam and at the section being studied, was designated as fringe N, and was so marked on the photograph of I. The motion of fringe N was carefully observed as the load was increased from the initial to the final value. The final fringe pattern, F was then photographed and the same fringe N was marked thereon for future identification and correlation of the two photographs.

Each of the fringe patterns I and F was then surveyed in the region of the neutral axis with a filar micrometer microscope, and the vertical location of each fringe was carefully determined with respect to the two scribe

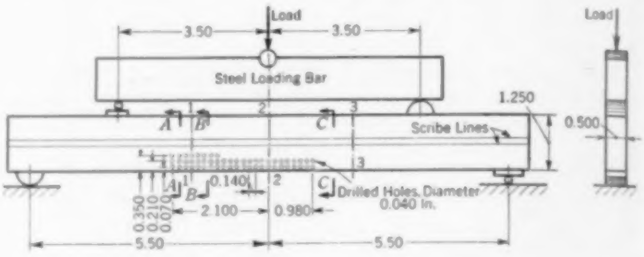
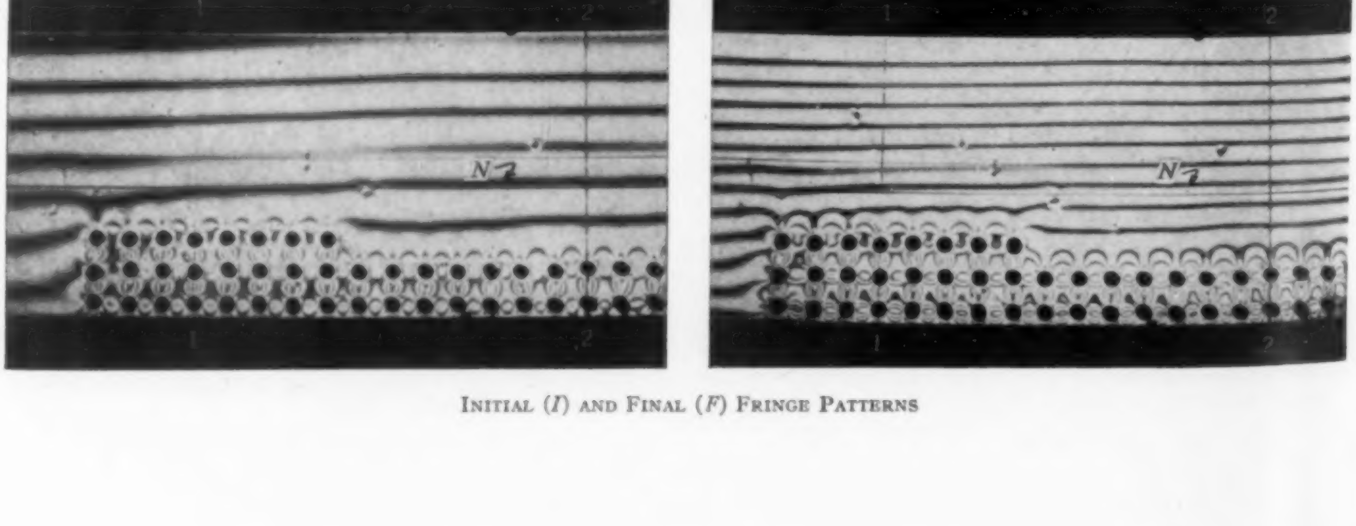


FIG. 1. METHOD OF LOADING, AND DIMENSIONS OF MODEL
All Dimensions Are in Inches

lines shown in Fig. 1. (These lines, marked on the beam itself, had been precisely located with respect to the top and bottom of the beam by means of microscopic measurements, and were visible on the photographs.) The fringe orders ($N-1$, N, $N+1$, etc.) were then plotted against the respective distances of these fringes from the top of the beam, the data from patterns I and F being shown on the same set of axes (Fig. 2). The point at which the two plotted lines intersect is the point at which the fringe order did not change during an increase in the load, and consequently is a point on the true neutral surface.

It would have been possible to eliminate the use of the initial fringe pattern and work directly from zero to final load, if the model had been entirely free from stress. However, it was believed that the precision of the results would be increased by following the common testing procedure and working between an initial load and a final load. Some small errors were probably eliminated in this way.

The use of the filar micrometer microscope, coupled with excellent illumination provided by light transmitted through the photographic negative, allowed the determination of the distance of a fringe from the top of the beam within a limit of error that did not exceed ±0.001 in., which is very small in comparison with the actual displacement of the center of gravity (see Table I). The curves were therefore plotted to an exaggerated scale,



INITIAL (I) AND FINAL (F) FRINGE PATTERNS

using a magnifying glass, a needle point, and a steel scale reading to 0.01 in.

The procedure just described was repeated at sections 1, 2, and 3, shown in Fig. 1. The properties of these cross-sections are shown in Fig. 1 and in Table I.

Another precise method of surveying the photographs is to enlarge the patterns on a rigid screen by means of an ordinary projection lantern for slides. The centers of the fringes may be marked on the screen in pencil and the measurements made later. A circle, scribed on the model and of known diameter, furnishes

TABLE I. PROPERTIES OF SECTIONS

(1) Section	(2) Number of Holes	(3) Reduction in Area	(4) Displacement of Center of Gravity	(5) Ratio of Col. 4 to Half-Depth
1-1	3	9.6%	0.044 in	1:14.5
2-2	2	6.4%	0.033 in.	1:18.9
3-3	0	0	0	0

a convenient means of determining the magnification ratio. This method is surprisingly accurate and very rapid.

CONCLUSIONS

The neutral axis was found to be located at mid-depth of the beam at each of the sections examined, with an observed deviation not exceeding 0.002 in., the depth of the beam being 1.25 in. The accuracy of the work was verified by repetition. That this conclusion is not at variance with the requirements of equilibrium may be reasoned from a consideration of Fig. 3. It can be seen that in each case the magnitude of the stresses can be such as to produce the required amount of moment, as well as to satisfy the requirement that the summation of the tensile and compressive stresses at the section must

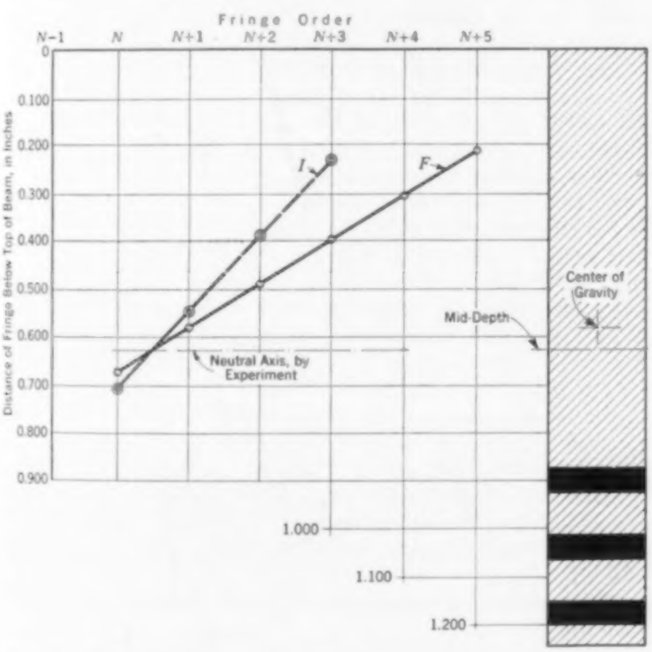


FIG. 2. TYPICAL PLOT FOR DETERMINING POINT AT WHICH FRINGE ORDER DID NOT CHANGE AS LOAD WAS INCREASED

equal zero. The diagrams shown in Fig. 3 are qualitative only, and do not represent the exact results of observations.

It is concluded from these experiments that the neutral axis of a riveted girder is not displaced by the presence of rivet holes, but remains coincident with the center of gravity of the gross cross-section. Of course, consideration should be given to the increase in stress at the line of rivet holes, where the reduction in area and the

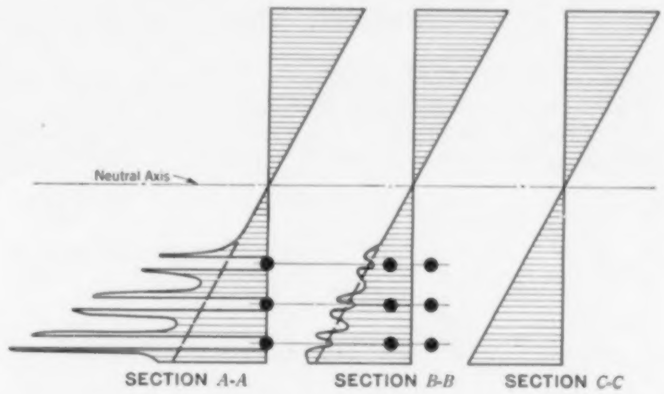


FIG. 3. QUALITATIVE REPRESENTATION OF STRESS DISTRIBUTION AT VARIOUS SECTIONS (SEE FIG. 1 FOR LOCATION)

stress concentration resulting from the presence of the holes are greater than would be calculated if no holes were present. This is particularly important if the holes are to be punched, or if the riveted member is to be subjected to reversal of stress.

Simplified Squaring of Numbers

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IN squaring numbers that are out of the range of the usual tables of squares, I have found the following method to be quite a time-saver:

1. Find in a table of squares the square of that part of the number to the left of the decimal point.
2. Write down the original number, but with only half the value of the figures to the right of the decimal point. Multiply this number by twice the value of the figures to the right of the decimal point.
3. The sum of the values found in (1) and (2) is the required square.

For example, let us square 122.35:

$$\begin{aligned}(122)^2 &= 14{,}884.0000\\ (122.175)(0.70) &= \underline{\phantom{14{,}8}85.5225}\\ (122.35)^2 &= 14{,}969.5225\end{aligned}$$

The same method can be used on much larger numbers by introducing an imaginary decimal point at any convenient position. For example, let it be required to find the square of 1,562.5. Write the number as 156.25, bearing in mind the true location of the decimal point. Then:

$$\begin{aligned}(156)^2 &= 24{,}336.0000\\ (156.125)(0.50) &= \underline{\phantom{24{,}3}78.0625}\\ (1{,}562.5)^2 &= 2{,}441{,}406.25\end{aligned}$$

It is quite apparent that the method gives a quick solution with little chance of error, and certainly less trouble than interpolating in log tables. The decimal point is of importance in the adding process only, and must be placed in the correct position in the answer.

Template for Rounding Cut Slopes in Highway Construction

By MILTON HARRIS, ASSOC. M. AM. SOC. C.E.
ASSOCIATE HIGHWAY ENGINEER, STATE DIVISION OF HIGHWAYS, BISHOP, CALIF.

THE rounding off or "baldheading" of highway slopes is a recent construction innovation that has a twofold purpose. It prevents the raveling of tops of slopes and the consequent accumulation of debris in the ditches,

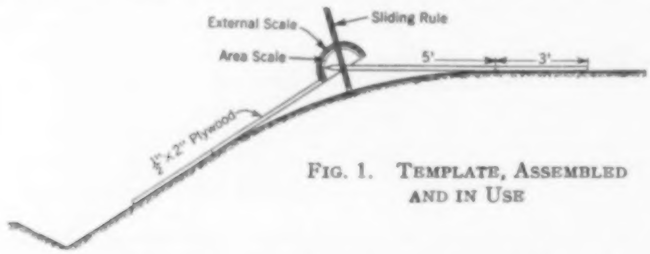


FIG. 1. TEMPLATE, ASSEMBLED AND IN USE

and also has an esthetic value in removing the harsh demarcations of cut slopes by gently curving their upper outline into the natural surrounding slope. To assist the workmen in constructing these rounding slopes uniformly, a template has been devised that, in addition, can be used to measure the excavation removed.

Recent specifications provide that the curvature of the rounded slopes be of such radius that the semi-tangents of the curve fitted to both cut slope and natural ground above be 5 ft, measured from the point of intersection of these slopes or from the position of the slope stake. Referring to Fig. 1, it will be seen that the template consists of two movable legs and a sliding scale, or rule, all pinned together by a bolt and locked in position by a wing nut on the reverse side. A pointer on one leg indicates on the outer scale of the arc (Fig. 2) the external distance corresponding to the angle between the cut slope and the natural slope. The sliding rule actually measures the external distance.

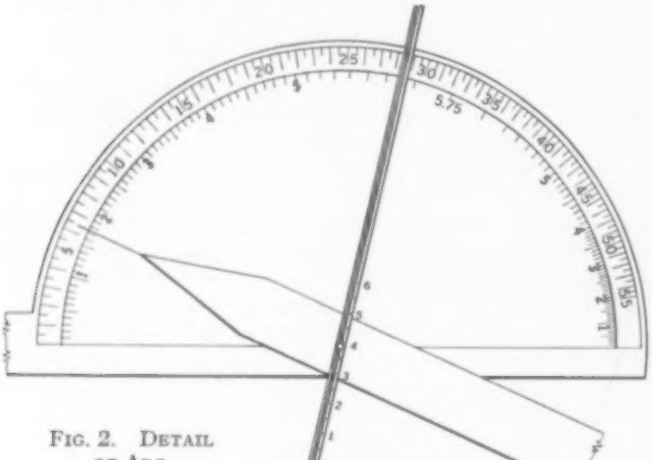


FIG. 2. DETAIL OF ARC

When the reading on the sliding rule equals the arc reading, the bottom of the sliding rule rests on the circumference of an arc tangent to the legs at 5 ft from the point of intersection of the slopes. The rule is set by eye at an angle that bisects the interior angle formed by the two legs. In actual use it has been found convenient to determine the indicated external, set the sliding rule to this external by digging a hole under it to the proper depth, clamp the template, mark the 5-ft points on the slopes, and excavate the material on a curve tangent to the three points indicated. The completed work is afterwards checked by applying the locked template to the excavated ground.

SLOPE-ROUNDING OPERATIONS

For example, suppose the cut slope and natural ground intersect at such an angle that the indicator reads $6^1/_2$ in. on the external scale. The ground is roughly excavated under the template arc so that the sliding rule rests in the excavated ground and reads $6^1/_2$ in. at the center pin. It is necessary to offset the scale on the rule in order to allow for the distance from the center pin to the lower edge of the legs.

Templates are applied along a slope at intervals dictated by the experience of the slopers. The beginning and ends of cuts may have a cut slope of less than 5 ft, in which case the opposite leg is laid parallel to the natural ground, the arc read for external, which is directly proportioned to the semi-tangent, and the measurement made by hand rule from the point of intersection of the ground slopes. It will be found, however, that an experienced sloper will warp his slopes from the full arc to zero at the ends of cuts by eye.

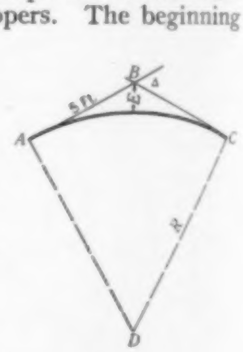


FIG. 3.

The inner scale on the arc (Fig. 2) gives the area of the portion removed for any given setting of the legs. From this the volume can be computed in the usual manner. This is a valuable adjunct where the rounding of slopes is paid for as extra or additional work. For semi-tangents other than 5 ft, the areas are proportional to the square of the semi-tangent.

The method of computing the arc scales is as follows (see Fig. 3):

$$\text{Area } ABCD = 5R$$

$$\text{Area } ACD = \frac{\pi R^2 \Delta}{360}$$

$$R = 5 \cot \frac{\Delta}{2}$$

$$\text{Area excavated} = 5R - \frac{\pi R^2 \Delta}{360}$$

$$= 25 \cot\frac{\Delta}{2} - \frac{25\pi\Delta}{360}\cot^2\frac{\Delta}{2}$$

From the plot of this equation (Fig. 4), the even square

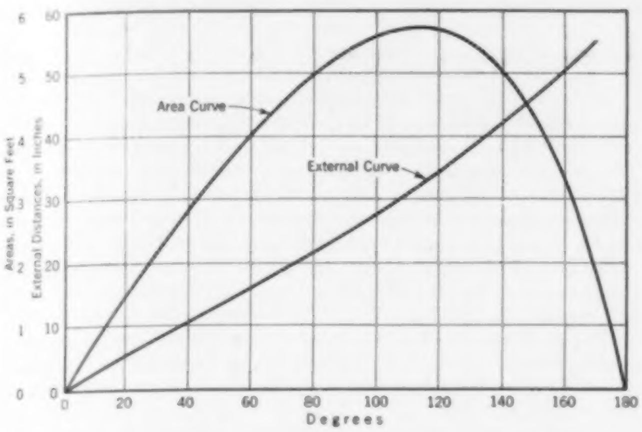


FIG. 4. PLOT OF EQUATIONS FOR AREA AND EXTERNAL

feet and tenths can be transferred to the template arc by means of a large protractor.

Referring again to Fig. 3, $E = R \text{ exsec}\frac{\Delta}{2}$. Expressed in inches, $R = 60 \cot\frac{\Delta}{2}$. Therefore $E = 60 \cot\frac{\Delta}{2} \text{exsec}\frac{\Delta}{2}$. This equation, also plotted on Fig. 4, can similarly be transferred to the template arc.

Shearing Stress in Steel Beams

By BRUCE JOHNSTON, ASSOC. M. AM. SOC. C.E.

INSTRUCTOR IN CIVIL ENGINEERING, COLUMBIA UNIVERSITY, NEW YORK, N.Y.

IN the design of steel structures there is a trend towards higher allowable working stresses. Such an increase is justified only if it is accompanied by first, increased accuracy in the calculation of stresses, and second, by substituting more precise methods of calculation for approximate methods used previously. If both these steps are taken, the result is a trend towards a real factor of safety in design.

In designing a short steel beam where shear may be the controlling factor, the design is sometimes based on an average shear stress determined by a web area equal to the total depth of the beam multiplied by the web thickness. The actual maximum shear stress may be calculated by the well-known formula found in textbooks on strength of materials:

$$v_{max} = \frac{V}{wI}\int_{y=0}^{y=d/2} y\,dA \qquad [1]$$

where V is the total shear; w, the web thickness; and I, the moment of inertia of the section.

The average shear stress in some beam sections is as much as 15 per cent lower than the actual maximum stress. The higher-than-average shear stresses extend over a considerable area of web and are therefore not comparable to local concentrations of stress which might properly be disregarded. The error is on the unsafe side and is recognized, according to Thomas Shedd, in his book, *Structural Design in Steel*, page 78, but has been taken care of by maintaining low allowable unit stresses. Is this the correct procedure?

In a recent investigation of the buckling strength of steel beams, by Lyse and Godfrey, titled "Investigation of Web Buckling in Steel Beams" and published in the TRANSACTIONS of the Society, Vol. 100 (1935), pages 675–695, it was found that rolled beams failed in shear rather than in diagonal buckling, even for web over depth ratios as low as 1:70. In this investigation a good correlation was found between shearing yield point of the material and shearing stresses in the beam calculated for a web area based on clear distance between the flanges. This method of calculation gives stresses much closer to the maximum stress but there is still a slight discrepancy, usually on the unsafe side.

Designing for the actual maximum shear stress due to loading is quite as simple a procedure as designing for maximum direct stress due to bending. In a short beam centrally loaded, the maximum shear stress has a more definite relation to the structural failure of the beam than does the maximum direct stress in a long beam centrally loaded. This is because the shear stress critically affects a proportionately greater portion of the total beam than do the bending stresses. Hence it is quite as important in certain cases to design for maximum shear stress as for maximum direct stress.

The actual calculation of maximum shear stress would be facilitated if the steel handbooks furnished tables of

$$Q = \int_{y=0}^{y=d/2} y\,dA \qquad [2]$$

in addition to the present tables of

$$I = \int_{y=-d/2}^{y=+d/2} y^2 dA \qquad [3]$$

Then the maximum shear stress would simply be

$$v_{max} = \frac{VQ}{wI} \qquad [4]$$

It might be considered better to supply a table of the Q/I ratio, which would further simplify the calculation.

In the absence of such tables a very close approximate formula, convenient for use with steel handbooks, and giving results within a fraction of 1 per cent is

$$v_{max} = \frac{V}{wI}\left[\left(\frac{A - A_w}{4}\right)d_e + \frac{A_w d}{8}\right] \qquad [5]$$

where A = gross area of section, from handbook
A_w = area of web based on total depth of beam ($A_w = wd$)
d_e = effective depth of section or distance between centroids of flanges, which may be taken approximately as the total depth of the beam less the average thickness of one flange
d = over-all depth of section

Although the design of beams for average rather than for maximum shear stress has been sanctioned by long practice, it would seem in keeping with present-day design methods to raise the allowable shearing stress in the web of beams and then base the design on actual maximum stresses.

OUR READERS SAY—

In Comment on Papers, Society Affairs, and Related Professional Interests

New York's First Subway

To the Editor: On page 30 of the January number of Civil Engineering there is an illustration of the Beach Pneumatic Railway, which ran under Broadway in New York City.

I was working in New York at the time of its construction, having arrived late in November 1868, and went to see the tunnel which was on exhibition.

No particulars of the scheme are given in Civil Engineering but, as I recall, the tunnel was built very smooth on the inside, and the car very smooth on the outside, giving a pretty close fit between the two.

The exhibitor said the car was to be propelled by air. I have forgotten the details (if he gave anything but a general description), but I think the car was to be blown along by a gust of air applied to the whole surface of the end of the car—though possibly the air was applied in some other manner.

At the same time the first elevated railway—a single-track structure, as I recall—was being built, on Ninth Avenue. It had iron posts on the edge of the sidewalk. These posts, which were the shape of the letter "Y," held the girders that carried the track, the center of which was open. An endless cable ran below the track for a few blocks, and was operated by an engine at one end. An arm, with which the motorman could engage the cable, hung down from the car.

I realize that this is an inadequate description of both tunnel and elevated. But I was very young, with no experience of such things, and it was nearly seventy years ago. Even so, these reminiscences may interest readers of Civil Engineering.

C. D. Purdon, M. Am. Soc. C.E.
Retired Consulting Engineer, St. Louis Southwestern Railway

St. Louis, Mo.
February 26, 1938

Great Benefits from a National Highway

To the Editor: Recent news items concerning a federal-built transcontinental highway have rekindled the fires of a dream that many a highway engineer has had. As one who has had such a dream, I should like to make a few suggestions for a great national highway that will link the Atlantic with the Pacific, together with the national crossroads sufficient to serve the needs of the communities north and south. A right of way 500 ft wide running in a western direction along the degree of latitude that passes through the national capital would be sure to catch the fancy of the public. Actual construction work would provide millions of days of work. The north-south routes would supplement a popular project with a work program that has had no equal in history.

The two important reasons why a public enterprise of this magnitude should be attempted at this time are (1) the provision of work for the millions along the highway and the indirect benefits for every industry affected, and (2) the provision of a line of communication for men, munitions, and materials to and from every important center and vulnerable point in the country. Every state traversed would benefit immediately, and every other state would feel the influence of so large a public-works project. Years ago the building of new transcontinental railroads had the same beneficial effect on all industry that we may fairly expect would follow the building of this highway. Also, the military necessities of the nation demand some such great coast-to-coast highway for purposes of moving men and materials in excess of what the rail lines can handle.

My idea would be a great wide divided highway running almost in a straight line, with a very low fixed maximum grade at any point. Valleys would be bridged and tunnels driven where necessary. In the light of present-day events this would be practical. As long ago as 1912 we completed a 60-mile line of railroad that ran west from Pittsburgh, and in that short distance some 30 bridges were built and 17 tunnels constructed. We kept the grades low. The military authorities could no doubt work out a plan of defense that would prove adequate under all conditions. The mountain areas would provide sites for great storehouses, quarried out of nature's best materials, and appropriate heights for defense weapons. Men, food, and munitions could easily be protected. In the prairie and flat sections of the country great subsurface works and connecting tunnels could be provided for the storage of foodstuffs and all implements of war for defense and offense. The imagination knows no bounds in contemplating the facilities for moving and protecting both men and supplies that a great national highway would provide.

The estimated employment figures, the investment required, and the probable income are as follows: men directly employed, one million for two or more years; men indirectly employed, two million for many years; initial investment, two billion dollars; and tolls collectable, forty million dollars the first year, two hundred million dollars the fifth year.

The increased value of real property along the right of way would alone provide sufficient increase in the tax rolls to warrant this large outlay of public funds.

George O. Woodelton, Affiliate Am. Soc. C.E.
Real Estate Appraiser

Long Island City, N.Y.
March 9, 1938

The Sanitary Engineer Faces New Problems

To the Editor: In his paper on "Full-Time Health Service and Travel Safety," in the October issue, K. E. Miller has emphasized man's dependence upon his environment. Created to live a nomadic life, he has by his own energy redesigned his mode of life, and this change has developed health problems. The very existence of our metropolitan centers is dependent upon our ingenuity in establishing public health safeguards. The first spectacular advances in freeing our urban centers from the devastating effects of filth-borne disease and lack of sanitation were made by the engineer who now assures the householder a safe and potable water supply. In crowded urban areas the rate of death from waterborne diseases would be appalling without the benefit of sanitary science.

Throughout the ages the spread of infection has depended upon man's transportation facilities. The faithful pilgrims who visited Mecca returned to the continent infested with the germs of cholera, plague, and smallpox. This devastation moved at the speed of the ship, the horse, or the donkey, which were the means of travel. With the development of railroads, automobiles, and airplanes as common carriers, the speed at which disease can be disseminated has increased proportionately. As Dr. Miller states, there is evidence that in a health sense the United States is but a few hours removed from the endemic yellow fever of Brazil. In the recent pandemics of influenza we have seen the rapid transfer of disease from one populous area to another and its rapid dissemination from these centers the into more rural districts.

Now, a new problem arises with the tendency of city dwellers to travel by automobile and trailer into the more rural counties. City people who have enjoyed the advantages of a protected supply, effective sanitary services, and modern housing facilities, are increasingly exposing themselves to the hazards of the undeveloped rural areas. At the same time they are introducing new health problems for the rural folk. When searching for a suitable summer resort, we are too apt to consider the facilities for golf, tennis, swimming, and dancing and pay too little attention to the means

employed for the disposal of human waste and for the safeguarding of the water, milk, and food supplies. Fortunately, with this obliteration of the difference between city and farm, county health departments are being established and operated under the direction of well-trained, full-time public health officers assisted by trained sanitarians and sanitary engineers and aided by the public health nurse.

Although the social security fund has assisted in materially increasing the number of full-time county health services until now there are about 830 such organizations, it must be remembered that there are nearly three times this number of counties in the United States which remain unorganized. These counties are no longer protected by their relative isolation, but increasingly require the type of service that sanitary science is prepared to offer. Even with this federal aid, there is grave danger that the funds for local public health service will dry up and disappear unless the sanitary engineer cooperates with the medical officer and public health nurse in increasing community interest in the preservation of health. The requisite knowledge with which to prevent disease is in our hands. We realize only too fully the relationship between a polluted water supply, a discharging sewer, an overcrowded tenement, and the spread of disease. The unsupervised camp ground, the temporary dwelling on wheels, and the insanitary rural food establishment are all factors in the needless dissemination of infection. Possessing these facts, we must stimulate public opinion so that there will be a demand for health protection. This requires a pooling of the resources of medicine, sanitary engineering, and health education. The sanitary engineer was a pioneer in the public health field, and the engineer has an important and key position to fill in the modern plan for health protection and for the promotion of hygienic living.

HENRY F. VAUGHAN
Commissioner of Health

Detroit, Mich.
March 1, 1938

Deflections in Beams Subjected to Combined Flexure and Direct Stress

TO THE EDITOR: In an article by Francis P. Witmer, M. Am. Soc. C.E., in the December 1937 issue, equations were given for the deflection of a beam when acted upon by vertical load and also by an axial horizontal force. In the February 1938 issue a letter in discussion of Professor Witmer's article, written by K. L. DeBlois, Assoc. M. Am. Soc. C.E., gave equations for a beam acted upon by vertical forces and also by a non-axial force.

The subject matter of these articles has been very useful to me recently in checking the stresses in a derrick boom. The forces (Fig. 1) acting on a boom when the boom is flat may be divided

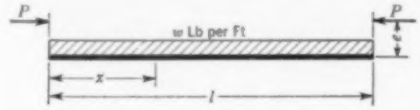


FIG. 1. FORCES ON BOOM

essentially into (1) a uniform vertical load due to the weight of the boom, and (2) a horizontal force acting at some eccentricity which is due to the horizontal component of the stress in the topping lift caused by the weight of the boom and the live load.

In order to determine the stress in the boom the true bending moment must be known. It can be expressed as

$$M_{\text{total}} = M_{\text{dead load}} + P(e + y)$$

But since the critical section is usually close to the center, where $y = \Delta$,

$$M_{\text{total}} = M_{\text{dead load}} + P(e + \Delta)$$

This case occurs very frequently. Formulas for the deflection, Δ, are in use today, but they are either unwieldy or inaccurate. However, from the general equation given by Professor Witmer (and his discusser, Mr. DeBlois) an accurate and very simple expression for Δ can be derived.

The general equation is:

$$y = A \sin nx + B \cos nx + \frac{M}{P} - \frac{d^2M}{dx^2} \cdot \frac{1}{n^2P} - e$$

Here A and B are constants, $n = \sqrt{\frac{P}{EI}}$, and M = dead load bending moment $= -\frac{wlx}{2} + \frac{wx^2}{2}$. Therefore,

$$y = A \sin nx + B \cos nx - \frac{wlx}{2P} + \frac{wx^2}{2P} - \left(e + \frac{w}{n^2P}\right) \ldots\ldots [1]$$

Now when $x = 0, y = 0$; whence $B = \left(e + \frac{w}{n^2P}\right)$. Further, when $x = \frac{l}{2}, \frac{dy}{dx} = 0$; whence by differentiating Eq. 1, equating to zero, and substituting the value of B previously determined,

$$0 = A \cos n\frac{l}{2} - B \sin \frac{nl}{2}$$

$$A = \left(e + \frac{w}{n^2P}\right) \tan \frac{nl}{2}. \quad \text{Finally,}$$

$$y = \left(e + \frac{w}{n^2P}\right) \sin nx \tan \frac{nl}{2} + \left(e + \frac{w}{n^2P}\right) \cos nx - \left(e + \frac{w}{n^2P}\right) - \frac{wlx}{2P} + \frac{wx^2}{2P}$$

This, then, is the equation of the curve of deflection for the beam when it is loaded as stated. When $x = \frac{l}{2}$, y is maximum, and equal to Δ:

$$\Delta = -\frac{W}{P}\left[\left(\frac{Pe}{W} + \frac{1}{n^2l}\right)\left(1 - \sec \frac{nl}{2}\right) + \frac{l}{8}\right]$$

Here $W = wl$. This equation is easy to solve if a table of trigonometric functions is at hand. However, it may be put into a purely algebraic form by means of converging series. The following is an accurate approximation:

$$\Delta = +\frac{W}{P}\left[\left(\frac{Pe}{W} + \frac{1}{cl}\right)\left(\frac{cl^2}{8} + \frac{5}{384}c^2l^4 + \frac{c^3l^6}{780}\right) - \frac{l}{8}\right] \ldots . [2]$$

(In Eq. 2, c represents P/EI.)

In the case where the eccentricity is zero,

$$\Delta = \frac{5}{384}\frac{Wl^3}{EI}\left(1 + \frac{Pl^2}{98\,EI}\right)$$

If values of the deflection, y, are desired at other points than the center, they may be found by substituting the proper values in the general equation for this case. However, a far simpler and speedier method is to assume that the resulting deflection curve will be a parabola. Then, since the middle ordinate, Δ, is known, the ordinates at other points can be easily found. Thus

$$y = \frac{x}{l} 4\Delta \left(1 - \frac{x}{l}\right)$$

in which y is the ordinate desired at a distance of x from one end.

FRANCIS L. SCHAFFEL, Jun. Am. Soc. C.E.
Draftsman, American Bridge Company

Pittsburgh, Pa.
February 25, 1938

Public Ownership of Land Desirable

DEAR SIR: In an article entitled "Social Horizons of the Engineer," in the November issue, Harry J. Engel, Assoc. M. Am. Soc. C.E., has presented a clear statement of prevailing economic conditions.

However, I should like to discuss the relative importance of two methods whereby society is exploited. The first of these is the "unearned income of large accumulations of wealth," and the second the ground rent which is demanded by those who are deemed to "own" the earth. For instance, has any industrial corporation an income comparable with that of the Astor family from ground rents in New York, or with that of the Westminster family in London? We might also consider the cases of the native rulers in India, who receive vast sums from improverished rayats. I have seen estimates of the total ground rental of Britain, ranging from £500,000,000 to £700,000,000 per year. But even if these figures were halved, would they not still exceed many times the total sum that accumulated money interests are capable of extracting from the British people? Wouldn't nearly all the shaded area in Mr. Engel's Fig. 4 be due to land rents? In other words, isn't the chief reason for the great difference between the wealth produced by labor and the return which labor receives due to the fact that so much of that wealth is diverted to those who claim to "own" the earth?

If practical recognition were given to Mr. Engel's suggestion that all land be regarded as belonging to society, this would involve the collection on behalf of society of the ground rent of all land, thus making it unprofitable to hold land idle. A considerable amount of land would then become available to laborers who are now unemployed.

Capital is that portion of wealth which is devoted to the production of more wealth, and all wealth is produced by labor from the earth. If follows then that capital is produced by labor and, provided access to land be obtainable, it is clear that labor can produce its own capital, thus dispensing with bankers if that is desirable, and also dispensing with other money lenders and big-business magnates. If this desirable condition can be brought about, as it can by restoring the land to the people, whose birthright it is, then money power will assume far less importance than is attributed to it today. We are driven to the conclusion that the remedy for most of the financial ills of the world lies in land restoration, and that maladjustment of income will continue until private monopoly of land is abolished.

Investigation shows that most excessive fortunes are based on land monopoly, and that high interest rates result from the inability of labor to obtain access to land from which to produce its own capital. Land restoration should remedy both these ills. Moreover, if land is made available to would-be users thereof, then there will be no necessity for incurring risks in occupying land liable to floods, or for attempting to clear land of the natural vegetation which prevents the removal of surface soil by wind storms.

With land restoration an accomplished fact, I do not think it will be necessary to legislate concerning rates of interest or the sending of money overseas. Some money sent overseas brings back to the lending country compensation for any ill effects that the lending country may suffer. Also, it must be remembered that money in the form of coin or bullion is transferred from country to country very rarely; normally the loan reaches the borrowing country in the form of goods, and the producers of such goods benefit by such transactions.

I hope many more young engineers will follow Mr. Engel's example and study social problems.

GEORGE HIGGINS, M. Am. Soc. C.E.
Consulting Engineer

Melbourne, Australia
February 15, 1938

[*Editor's Note:* It should be noted that in Fig. 6 of the article under discussion the symbol "%" appears by mistake in the column, "Income in Billions." The figures 10, 12, 10.5, 14.0 . . . represent billions of dollars, not percentages.]

Zoning Adjacent to Highways

TO THE EDITOR: I was interested in the article on "Thoroughfare Plans and Urban Areas," by Frank H. Malley, Assoc. M. Am. Soc. C.E., in the December issue, and in the subsequent discussion. It may or may not be helpful to zone lands adjacent to a highway whose construction would normally result in their depreciation. Although the effect of zoning is primarily negative, it may contribute indirectly to positive results as does the blocking of other outlets to force the use of the one desired.

One frequently notices that former highly regarded residential sites have been abandoned as such along highways having heavy traffic. Even if the land adjacent to these highways were zoned for such use, residences would not be maintained there for various good reasons, and it would simply remain idle and worthless for such purposes. On the other hand, if sufficient width of right of way were provided between the roadways and the private property zoned for residences, and if this intervening width were suitably landscaped and cared for, and if service roadways that did not seriously interfere with the through traffic were established in it for the convenience of residents, then the zoning might prove a great help in preventing a lower use and in encouraging a higher use of the land, despite the annoyances from the traffic route.

Zoning is a decisive step toward preventing "such cheap developments as roadside stands, low-grade real-estate ventures and the like." Alone, it will not increase the value of roadside lands for residential purposes, and it may rob them of any private value except for dumps. On the other hand, zoning—with enough right-of-way widths or "elbow room"—may bring about that consummation devoutly to be wished.

W. W. CROSBY, M. Am. Soc. C.E.
Consulting Engineer

Coronado, Calif.
February 27, 1938

Sewage-Treatment Plant at Buffalo, N.Y.

TO THE EDITOR: I was interested in the artist's drawing of the proposed sewage disposal plant for the city of Detroit, Mich., shown on page 878 of the December issue of CIVIL ENGINEERING.

Perhaps your readers will be interested in the accompanying sketch of the Buffalo, N.Y., sewage-treatment plant. This sketch has been prepared from the actual construction drawings.

SAMUEL A. GREELEY, M. Am. Soc. C.E.
Greeley and Hansen, Hydraulic and Sanitary Engineers

Chicago, Ill.
February 27, 1937

THE BUFFALO, N.Y., SEWAGE TREATMENT PLANT

Spring Meeting in Jacksonville, Fla.

Held Jointly with the Florida Engineering Society, April 20–23, 1938

General Meeting, *Wednesday—April 20, 1938—Morning*

9:00 **Registration**

10:00 **Spring Meeting called to order by**

J. A. Long, *M. Am. Soc. C.E., President, Florida Section; County Engineer, Duval County, Board of County Commissioners*, Jacksonville, Fla.

Invocation

Right Reverend Frank A. Juhan, *Bishop of Florida.*

10:05 **Addresses of Welcome**

A. L. Pfau, Jr., *Assoc. M. Am. Soc. C.E., President, Florida Engineering Society; Engineer and Contractor,* St. Petersburg, Fla.

His Honor, George C. Blume, *Mayor of the City of Jacksonville,* Fla.

His Excellency, Fred P. Cone, *Governor of the State of Florida,* Tallahassee, Fla.

10:25 **Response**

Henry Earle Riggs, *President, American Society of Civil Engineers; Honorary Professor, Civil Engineering, University of Michigan,* Ann Arbor, Mich.

10:30 **Recent Progress in Engineering Education in the Colleges and Universities of the Southeastern States**

F. C. Snow, *M. Am. Soc. C.E., Professor, Civil Engineering, Georgia School of Technology,* Atlanta, Ga.

10:50 **What the Pulp Industry Means to the Engineers of the South**

Warren T. White, *General Industrial Agent, Seaboard Air Line Railway,* Norfolk, Va.

11:10 **What Shall Be Done to Perpetuate the Pulp Industry in Florida**

Lewis E. Staley, *Forest Assistant, Florida Forest and Park Service,* Tallahassee, Fla.

11:35 **What the Phosphate Industry Means to Florida Engineers**

Herbert D. Mendenhall, *M. Am. Soc. C.E., Consulting Engineer,* Tallahassee, Fla.

12:25 **Announcements**

12:30 **Luncheon Recess**

1:00 **Student's Luncheon, Hotel George Washington**

P. L. Reed, *M. Am. Soc. C.E., Professor of Civil Engineering, College of Engineering, University of Florida,* Gainesville, Fla., *Presiding.*

Speaker: Thomas R. Agg, *M. Am. Soc. C.E., Dean of Engineering, Iowa State College,* Ames, Iowa, on "Engineering in This New Era."

All members of the Society will be welcome.

Tickets $1.00 each for members and guests; 50 cents each for students.

Avenue of Palms, St. Augustine, Fla.

Airplane View of Golf Course, Ponte Vedra Club

Wednesday—April 20, 1938—Afternoon and Evening

3:00 **Motor Trip to St. Augustine with Buffet Supper and Dancing at the Ponte Vedra Bath Club**

Members and guests will leave for a motor trip to St. Augustine, the oldest city in America, for an inspection of the restoration work of the Carnegie Institution of Washington. On arrival in St. Augustine, the progress of the Carnegie Institution in its restoration program will be explained by the Hon. David R. Dunham, following which members and guests will be conducted on a tour of the old city which will include visits to Old Fort Marion (San Marco), Oldest House in America, Fountain of Youth, and Indian Burying Grounds

7:00 **Buffet Supper**

At the conclusion of the visit to St. Augustine, the party will motor to the Ponte Vedra Bath Club where a buffet supper will be served.

Dancing, cards, and visiting will follow the supper.

Tickets for the trip to St. Augustine and supper are $3.50 each, and include admission to any three of the points of interest in St. Augustine to which admission is charged.

Wednesday—April 20, 1938—Morning

9:30 Student Chapter Conference

Chairman: C. D. Renshaw, *University of Florida Chapter.*

10:00 Student Papers

Speaker: Malcolm Pirnie, *Vice-President, Am. Soc. C.E.*

1:00 Luncheon

Sessions of Technical Divisions Occ

THURSDAY—April 21, 1938

SURVEYING AND MAPPING DIVISION

Hotel George Washington

Morning and Afternoon

9:00 **Proposed Improvements for Land Surveys and Title Transfers**

PHILIP KISSAM, *Assoc. M. Am. Soc. C.E., Associate Professor, Civil Engineering, Princeton University*, Princeton, N.J.

Discussion

10:15 **Progress of Control and Mapping in the State of Florida**

G. D. BARNHART, *Assistant Director, Florida Mapping Project*, Gainesville, Fla.

Discussion opened by

W. L. SAWYER, *Assoc. M. Am. Soc. C.E., Assistant Professor, Civil Engineering, College of Engineering, University of Florida*, Gainesville, Fla.

12:00 **Luncheon Recess**

2:00 **Survey Problems in the Retracement of Old Land Lines in Florida**

WYLIE W. GILLESPIE, *Engineer and Surveyor*, Tavares, Florida.

Discussion opened by

WINSTON E. WHEAT, *Assoc. M. Am. Soc. C.E., County Engineer, Escambia County*, Pensacola, Fla.

2:45 **Survey Problems in Duval County, Florida, with Special Reference to the Duval County System of Plane Coordinates and the Conversion of That System to the Mercator Transverse System as Established by the Coast and Geodetic Survey**

ARTHUR N. SOLLEE, *Assistant County Engineer, Duval County*, Jacksonville, Fla.

Discussion opened by

C. C. SCHRONTZ, *M. Am. Soc. C.E., Associate Engineer, U. S. Army Engineers*, Jacksonville, Fla.

3:30 **Adjustment of Old Surveys and Descriptions to Fit Present-Day Lines of Occupation**

RALPH E. WENDT, *Member, F.E.S., Assistant City Engineer*, Jacksonville, Fla.

Discussion opened by

HON. PETER KENDRICK, *Past-President, F.E.S., Consulting Engineer*, St. Augustine, Fla.

H. M. WHITE, *Member, F.E.S., Land Surveyor*, Orlando, Fla.

SANITARY ENGINEERING DIVISION

Hotel George Washington

Morning and Afternoon

9:30 **Runoff of Florida Streams**

DONALD S. WALLACE, *Assoc. M. Am. Soc. C.E., District Engineer, U. S. Geological Survey*, Ocala, Fla.

10:00 **Ground Water Supplies in Florida and the Southeastern States**

V. T. STRINGFIELD, *U. S. Geological Survey*, Washington, District of Columbia.

10:30 **Treatment and Use of Artesian and Surface Water for Municipal and Industrial Purposes**

MALCOLM PIRNIE, *M. Am. Soc. C.E., Consulting Engineer*, New York, N.Y.

11:00 **Discussion opened by**

JOHN F. REYNOLDS, *M. Am. Soc. C.E., Consulting Engineer*, Jacksonville, Fla.

CHARLES E. RICHHEIMER, *Assoc. M. Am. Soc. C.E., Vice-President, G. A. Youngberg and Associates, Inc.*, Jacksonville, Fla.

HERMAN GUNTER, *Member, F.E.S., State Geologist*, Tallahassee, Fla.

12:00 **Luncheon Recess**

2:00 **Effect of Industrial Waste and Sewage on Shell Fish and Food Fish**

L. M. FISHER, *M. Am. Soc. C.E., Sanitary Engineer in Charge, U. S. Public Health Service*, Washington, D.C.

Discussion opened by

G. F. CATLETT, *Chief Engineer, State Board of Health*, Jacksonville, Fla.

3:00 **Sewage Problems in Coastal Towns**

C. S. NICHOLS, *M. Am. Soc. C.E., Director of Public Service*, Miami, Fla.

Discussion opened by

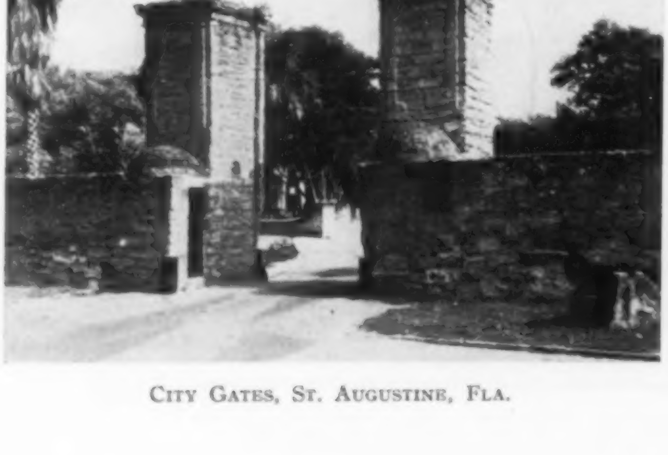
MORRIS N. LIPP, *Assoc. M. Am. Soc. C.E., City Engineer*, Miami Beach, Fla.

4:00 **Engineering Phases of Malaria Control**

L. M. CLARKSON, *Director of Sanitary Engineering, Georgia State Department of Public Health*, Atlanta, Ga.

Discussion opened by

H. D. PETERS, *Sanitation Engineer, City Health Department*, Jacksonville, Fla.



CITY GATES, ST. AUGUSTINE, FLA.

OLD SLAVE MARKET, ST. AUGUSTINE, FLA.

Occupy the Entire Day

THURSDAY—April 21, 1938

JOINT SESSION OF WATERWAYS DIVISION AND AMERICAN SHORE AND BEACH PRESERVATION ASSOCIATION

Hotel George Washington

Morning and Afternoon

9:00 **Registration**

9:30 **Meeting called to order**

(1) **Beach and Coast Erosion**

EARL I. BROWN, *M. Am. Soc. C.E., Colonel, Corps of Engineers, U.S.A.; Division Engineer*, Richmond, Va.

Discussion opened by

MORRIS N. LIPP, *Assoc. M. Am. Soc. C.E., City Engineer*, Miami Beach, Fla.

GILBERT A. YOUNGBERG, *M. Am. Soc. C.E., Colonel, Corps of Engineers, U.S.A. (Retired); President, G. A. Youngberg and Associates, Inc.*, Jacksonville, Fla.

(2) **Studies on Beach and Coast Erosion in the Wave Tank at Fort Belvoir, Va.**

FRANK O. BOWMAN, *Captain, Corps of Engineers, U.S.A.; Resident Member, Beach and Shore Protection Boards*, Washington, D.C.

(3) **Beach Preservation Works at Winthrop Beach, Mass.**

RICHARD K. HALE, *Assoc. M. Am. Soc. C.E., Associate Commissioner, State Department of Public Works*, Boston, Mass.

General Discussion

2:00 **Opening of Afternoon Session**

(1) **Address by**

HON. FINLEY W. PARKER, *President, American Association of Port Authorities*, Galveston, Tex.

(2) **Improvements on St. Johns River and Harbor**

GILBERT A. YOUNGBERG, *M. Am. Soc. C.E.; Colonel, Corps of Engineers U.S.A. (Retired); President, G. A. Youngberg and Associates, Inc.*, Jacksonville, Fla.

Discussion opened by

EARL NORTH, *Lieutenant-Colonel, Corps of Engineers, U.S.A.; District Engineer, U. S. Engineer Office*, Jacksonville, Fla.

(3) **Model Studies—Hell Gate Channel**

PAUL W. THOMPSON, *Jun. Am. Soc. C.E., Lieutenant, Corps of Engineers, U.S.A.; Director, U. S. Waterways Experiment Station*, Vicksburg, Miss.

Discussion

(4) **Galveston Beach**

COURTENAY C. WASHINGTON, *M. Am. Soc. C.E., County Engineer and County Surveyor*, Galveston County, Galveston, Tex.

(5) **Three Years' Progress in Beach Matters on the California Coast**

GEORGE HJELTE, *Superintendent, Department of Playground and Recreation*, Los Angeles, Calif.

Discussion

BRIDGES OVER ST. JOHNS RIVER, JACKSONVILLE, FLA.

HIGHWAY DIVISION

Hotel George Washington

Morning and Afternoon

9:30 **The Highway Industry's Importance in the National Economy**

CHARLES M. UPHAM, *M. Am. Soc. C.E., Engineer-Director, American Road Builders' Association*, Washington, D.C.

Discussion opened by

W. R. NEEL, *Director, Post Roads Division, State Highway Board of Georgia*, Atlanta, Ga.

10:15 **Building Safety Into the Design and Construction of Highways**

HARRY J. MORRISON, *M. Am. Soc. C.E., Senior Highway Engineer, U. S. Bureau of Public Roads*, Gainesville, Florida.

Discussion

11:00 **Conversion of Florida Overseas Railroad Into a Highway**

B. M. DUNCAN, *General Manager, Overseas Road and Toll Bridge District*, Key West, Fla.

Discussion

12:00 **Luncheon Recess**

2:00 **The Use of Local Materials in the Construction of Highways in the Southeastern States**

J. H. DOWLING, *Assoc. M. Am. Soc. C.E., State Highway Engineer, State Road Department*, Tallahassee, Fla.

Discussion opened by

B. P. MCWHORTER, *Assoc. M. Am. Soc. C.E., Senior Highway Engineer, U. S. Bureau of Public Roads*, Montgomery, Ala.

2:45 **Soil Stabilization Methods in the Southeastern States**

H. C. WEATHERS, *Member, F.E.S., Division Engineer of Tests, Florida State Road Department*, Gainesville, Fla.

Discussion

3:15 **Soil Sampling and Testing**

W. H. MILLS, JR., *Testing Engineer, State Highway Department*, Columbia, S.C.

THURSDAY—April 21, 1938—Evening

7:00 Dinner and Dance—Hotel George Washington

TOASTMASTER: W. E. REYNOLDS, *M. Am. Soc. C.E., Assistant Director of Procurement, Public Buildings Branch, U. S. Treasury Department*, Washington, D.C.

SPEAKER: WILLARD T. CHEVALIER, *M. Am. Soc. C.E., Vice-President, McGraw-Hill Publishing Company, Inc.*, New York, N.Y.

Tickets for dinner and dance, $3.00 each.

Florida Engineering Society Meets Thursday

THURSDAY—April 21, 1938—Morning

ELECTRICAL PROGRAM OF FLORIDA ENGINEERING SOCIETY

Hotel Seminole

A. P. MICHAELS, *Chairman, Florida Section, A.I.E.E., Presiding*

10:00 Report of the Committee on Electrical Engineering
W. AUSTIN SMITH, *M. Am. Soc. C.E., Consulting Engineer*, Jacksonville, Fla., *Chairman.*

10:15 Contributions of the Engineer to Aeronautics
R. C. GAZLEY, *Chief, Safety and Planning Division, Department of Commerce*, Washington, D.C.

10:45 The Engineer
E. D. WOOD, *Vice-President, Fourth District, A.I.E.E.*, Louisville, Ky.

11:15 Studies in Radio Static as Applied to Meteorological Problems
JOSEPH WEIL. *Director, F.E.S., Acting Dean, College of Engineering, University of Florida*, Gainesville, Fla.

11:45 Electrical Control for Automatic Zeolite Treatment Plants
W. AUSTIN SMITH, *M. Am. Soc. C.E., Consulting Engineer*, Jacksonville, Fla.

12:15 Discussion

12:30 Adjournment for Lunch

THURSDAY—April 21, 1938—Afternoon

MECHANICAL PROGRAM OF FLORIDA ENGINEERING SOCIETY

Hotel Seminole

C. M. LOWRY, *Chairman, Florida Section, A.S.M.E., Presiding*

2:00 Report of Committee on Mechanical Engineering
W. A. LAWRENCE, *Florida Power and Light Company*, Miami, Fla., *Chairman.*

2:15 The Increasing Industrial Significance of the South
E. W. O'BRIEN, *Past Vice-President, A.S.M.E., Managing Director, "Southern Power Journal,"* Atlanta, Ga.

2:45 Pulp and Paper Processes for Southern Pine
D. G. MOON, *Chief Engineer, Union Bag and Paper Corporation*, Savannah, Ga.
(This paper will be illustrated by moving pictures covering the complete process of Union Bag and Paper operations at the Savannah plant.)

3:15 Recent Developments in Steam Generation
PAUL R. YOPP, *District Manager, Babcock and Wilcox Company*, Atlanta, Ga.

3:45 Industrial Control Problems
M. J. MCWHORTER, *District Manager, Bailey Meter Company*, Atlanta, Ga.
(This paper will be illustrated with slides.)

4:15 Economic Possibilities of Reversed Refrigeration for Heating in Florida
S. P. GOETHE, *Graduate Assistant, Mechanical Engineering Department, University of Florida*, Gainesville, Fla.

4:45 Prize Paper, "Abrasives in the Service of Industry," by E. E. Bisson, Student Member, University of Florida

Discussion on papers and opportunity to get acquainted.

MUNICIPAL LIGHT PLANT, JACKSONVILLE, FLA.

TYPICAL RESIDENTIAL STREET, JACKSONVILLE, FLA.

Entertainment for the Ladies

WEDNESDAY—April 20, 1938

9:00 **Registration by Ladies' Reception and Registration Committee**

10:00 **Ladies Will Be Welcome at the Opening Session of the Spring Meeting**

12:30 **Luncheon**

Ladies' luncheon at Hotel Windsor.

Tickets $1.00 each.

3:00 **Motor Trip to St. Augustine with Members of Society**

Visit to Old Fort Marion (San Marco), Oldest House in America, Fountain of Youth, and Indian Burying Grounds.

Talk by HON. DAVID R. DUNHAM on the "Progress of the Carnegie Institution of Washington in the Restoration of the Old City of St. Augustine."

7:00 **Buffet Supper and Dance at the Ponte Vedra Bath Club**

At the conclusion of the visit to St. Augustine, the party will motor to the Ponte Vedra Bath Club where a buffet supper will be served.

Dancing, cards, and visiting will follow the supper.

Price for the St. Augustine trip, including transportation by automobile or bus, buffet supper, and dance at Ponte Vedra, will be $3.50 per person. This price includes admission to any three of the points of interest in St. Augustine to which admission is charged.

THURSDAY—April 21, 1938

2:20 **Sightseeing Trip Around City and Vicinity**

Transportation will be by bus.

4:30 **Tea, Jacksonville Woman's Club**

Tickets may be obtained at the registration desk without charge.

Ladies will be returned to the hotel about 5:30 p.m.

7:00 **Dinner-Dance, Hotel George Washington**

Tickets $3.00 each.

HOTEL PONCE DE LEON, ST. AUGUSTINE, FLA.

NEW FEDERAL BUILDING, JACKSONVILLE, FLA.

All-Day Excursion to Ocala and Silver Springs

FRIDAY—April 22, 1938

9:00 Leave Jacksonville by Special Train

11:00 Arrive Ocala

Upon arrival at Ocala, members of the party will be met by automobiles, and after driving around Ocala the party will be taken to Silver Springs. At that point a barbecue luncheon will be served and members and their guests will be taken for trips on the Springs in glass-bottomed boats. An excellent view of underwater life is thus obtained. Silver Springs is one of the largest fresh water springs in the country, having an average flow of about 1,000 cu ft per sec. Guests will be driven back from Silver Springs to Ocala in time to catch the train leaving Ocala at 3:45 p.m. and arriving in Jacksonville at 6:10 p.m.

The total cost of this trip, including railroad fare, automobile trip, luncheon, and trip in the glass-bottomed boats, will be $7.00.

There are several excellent highways from Jacksonville to Silver Springs, and the distance is approximately 110 miles. Persons wishing to drive to Silver Springs in their own cars may do so. The charge to such persons for luncheon and the trip on the Springs will be $2.00.

Members who wish to go on by rail to points in South Florida after the Silver Springs trip may do so direct from Ocala. Such members will buy round-trip tickets from Jacksonville to South Florida points, and will then be charged $2.75 each for the motor trip from Ocala, the luncheon, and the trip in the glass-bottomed boat.

Special 15-day round-trip tickets (good in Pullman cars) from Jacksonville to the following South Florida points are as follows, also one-way lower-berth rates:

From Jacksonville to	Rail Fare	Lower Berth, One Way from Ocala
West Palm Beach	$13.50	$2.50
Miami	16.50	2.50
Tampa	9.55	2.00
St. Petersburg	11.35	2.00

The rail lines are planning to have a special Pullman or Pullmans placed at the station in Ocala at 9:00 p.m. for persons making this South Florida trip, should sufficient tickets be sold.

All round-trip tickets from Jacksonville to Miami over the Seaboard Air Line Railway are honored going or returning via Tampa, Sarasota, and St. Petersburg, without additional cost, thus permitting members to visit both coasts of Florida.

Side trips to Key West and Havana, Cuba, can be arranged.

Ticket office will be maintained at the Hotel George Washington, where tickets will be sold for these trips.

SCENE AT SILVER SPRINGS, FLA.

FINANCIAL DISTRICT, JACKSONVILLE, FLA.

SATURDAY—April 23, 1938

The following are points of interest for special trips for Saturday:

1. **Marine Studios at Marineland, Fla.**

   Many unique features both as to construction and operation of general interest.

2. **Fernandina Pulp Mills**
3. **Turpentine Plant, Naval Stores Experiment Station, Olustee, Fla.**
4. **Tung Oil Plant and Plantations, Gainesville, Fla.**

The Local Committee will make arrangements for any of these trips. The Local Committee will also make arrangements for those members who wish to see the Lake Okeechobee levees. These levees may be most easily reached by motor from West Palm Beach, a point on the main line of the Seaboard Air Line and Florida East Coast railroads at which through-sleepers are set off every morning.

Post Meeting Tour to Silver Springs, Ocala, St. Petersburg, Sarasota, Ringling Museum, Ybor City, Tampa, and Havana

Leave **Jacksonville**	Special Train	9:00 a.m., April 22

Arrive **Ocala** for sightseeing trip around Ocala, thence to Silver Springs for luncheon, after which members and their guests will be taken for trips on the Springs in glass-bottomed boats. An excellent view of the under-water life is thus obtained. Silver Springs, one of the greatest natural wonders, is one of the largest fresh-water springs in the country, having an average flow of about 1,000 cu ft per sec. Guests will then be driven back from Silver Springs to Ocala.

Leave Ocala	(Sleepers open 9:00 p.m.)	3:25 a.m., April 23

Arrive St. Petersburg

At St. Petersburg the party will be met by special buses for the trip through beautiful southern Florida to Sarasota for sightseeing. The Ringling Museum, one of the outstanding attractions of the state and nation, will be one of the features of the South Florida pilgrimage.

Following the Sarasota sightseeing trip, the party will return to Tampa for a Spanish dinner in unique Ybor City, a Cuban settlement adjacent to Tampa, after which the party will return to Tampa, stopping overnight at the Hillsborough Hotel.

HAVANA

Leave Port Tampa	P. & O. S. S. Co.	2:30 p.m., April 24
Arrive Havana	P. & O. S. S. Co.	3:00 p.m., April 25

$3^1/_2$ days and 3 nights in Havana. Features of Havana stay outlined below.

Leave Havana	P. & O. S. S. Co.	7:00 p.m., April 28
Arrive Miami	P. & O. S. S. Co.	8:00 a.m., April 29

Visit in and around Miami as each individual member desires; no set schedule being arranged, returning to Jacksonville as desired.

FEATURES OF TOUR

1. First Class rail and Pullman transportation for entire rail trips, Jacksonville to Ocala, thence to St. Petersburg, thence boat train from Tampa to Port Tampa, also from Miami returning to Jacksonville. (For those taking only the Ocala and Silver Springs trip, coaches will be provided.)
2. Sightseeing, luncheon, and trip on Springs at Ocala as outlined.
3. Sightseeing trip via bus from St. Petersburg to Sarasota, Ringling Museum, returning to Ybor City for Spanish dinner in the most popular and colorful restaurant, returning to hotel in Tampa.
4. Hotel accommodations in Tampa, European plan (for those en route to Havana).
5. Havana ($3^1/_2$ days and 3 nights in Havana), all-inclusive cost, features of which are:
   a) Round-trip steamship transportation from Port Tampa to Havana, returning to Miami. Meals and stateroom accommodations aboard ship while at sea.
   b) Cuban tourist tax.
   c) Transfer, including hand baggage, from docks in Havana to hotel and return.
   d) Accommodations in Havana at the Plaza, one of Havana's most popular and accessible hotels, American plan (two persons to the room).
   e) Two comprehensive sightseeing trips in Havana, including a city-country combination trip of approximately $4^1/_2$ hours; also an evening tour—"Seeing Havana at Night."
   f) Personally conducted tour through Cuba's new capitol building.
   g) A table d'hote meal (either dinner or luncheon) at one of Havana's finest and most popular restaurants—either the Cosmopolita or the Miami Restaurant.

Tour Costs

Tour A—Jacksonville to Ocala and Silver Springs, as outlined, returning direct to Jacksonville.................$7.00

Tour B—Jacksonville to Ocala and Silver Springs, thence to St. Petersburg, Ringling Museum, Ybor City for Spanish dinner, thence to Tampa, returning direct to Jacksonville with rail and Pullman lower-berth accommodations $24.30

Tour C—All the above, together with Havana side trip, including all features as outlined, returning to Miami via steamer, thence by rail and Pullman lower-berth accommodations to Jacksonville...............................$85.80

Those interested in Tours A and B should communicate directly with the Secretary's Office or with the Chairman of the Local Committee.

Tour A is identical with the Friday Excursion to Ocala and Silver Springs.

Hotel Accommodations and Announcements

In order to be certain of accommodations, members are urged to make definite arrangements for rooms at least a week in advance of the Spring Meeting, paying for the rooms in advance for at least part of the period for which they expect to be in Jacksonville.

Hotel Rates

Hotels	Single Rooms With Bath	Single Rooms Without Bath	Double Rooms With Bath	Double Rooms Without Bath
George Washington	$2.50 up	....	$4.00 up	....
Mayflower	2.00 up	....	3.50 up	....
Roosevelt	2.50 up	....	4.00 up	....
Seminole	2.50 up	....	3.50 up	....
Windsor	2.50 up	....	4.00 up	....
Windle	2.00 up	1.50	3.00 up	2.00 up

The Hotel George Washington is the headquarters for the American Society of Civil Engineers, the Hotel Seminole is the headquarters for the Florida Engineering Society, and the Hotel Roosevelt is the headquarters for the American Shore and Beach Preservation Association.

All who attend the Spring Meeting are requested to register immediately upon arrival at headquarters. Special badges and tickets will be obtained at the time of registration.

Rail and Pullman Fares to Jacksonville

From	Round-Trip Rail Fare	Lower Berth Fare Each Way	Train Hours to Jacksonville
Boston, Mass.	$65.30	$ 9.00	26 hours
New York, N.Y.	49.70	7.25	19 hours 55 mins
Washington, D.C.	36.30	5.75	15 hours 35 mins
Chicago, Ill.	49.60	8.00	24 hours
Pittsburgh, Pa.	54.40	8.00	22 hours 30 mins
Cleveland, Ohio	54.40	8.00	27 hours 35 mins
Detroit, Mich.	54.40	8.00	30 hours 25 mins
St. Louis, Mo.	42.40	7.00	22 hours 40 mins
Milwaukee, Wis.	53.45	8.50	26 hours 30 mins
Minneapolis, Minn.	67.95	10.25	33 hours 30 mins
Cincinnati, Ohio	39.60	6.00	23 hours 35 mins
Louisville, Ky.	35.65	6.00	19 hours 28 mins
New Orleans, La.	27.60	4.25	18 hours 45 mins
Atlanta, Ga.	15.40	3.00	8 hours 34 mins

Announcements and Committees

Local Sections Conference, Monday, April 18, 1938

A conference of representatives from the sixteen Local Sections in the Southern Meeting Region will be convened at 9:30 a.m. on Monday, April 18. The program will consist of discussions on topics of live interest to the engineering profession. All members of the Society will be welcome.

Student Chapter Conference

A conference of representatives from Student Chapters in the southern region is scheduled at 9:30 a.m. Wednesday, April 20, and will be followed by a Student Chapter luncheon. A program of particular interest to students has been prepared. Members of the Society will be cordially welcome at the conference.

Order All Tickets in Advance

Members who order tickets in advance not only will be saved delay by having tickets and badges awaiting them on arrival at headquarters, but they will assist the committee greatly by giving advance information to guide it in concluding arrangements.

Information

A registration desk will be provided in the headquarters hotel to assist visiting members in securing desired information about the city. At the registration desk a card file of those in attendance will be maintained, with information as to Jacksonville addresses.

Entertainment for the Ladies

Attention is directed to the entertainment provided for the ladies on Wednesday and Thursday. It is expected that they will participate with the members in any other features of the program in which they are interested.

Invitation to Student Members

Members of Student Chapters are invited to participate in all the events of the Spring Meeting. Particular attention is called to the Student Luncheon on Wednesday and to the dance following the dinner on Thursday.

Special hotel rates will be available to Students, and the Committee on Arrangements is planning to make reduced rates to Students for the St. Augustine trip on Wednesday and for the dinner and dance on Thursday evening.

State-wide Cooperating Committee

H. J. MORRISON, *Chairman, Representing American Society of Civil Engineers and Florida Engineering Society,*

Representing the American Society of Civil Engineers and the Florida Engineering Society

ALEXANDER BLAIR — E. FRIEDMAN
CHARLES A. BROWNE — A. L. PFAU, JR.
C. E. BURLESON — J. R. SLADE
O. P. ERICKSON — WINSTON E. WHEAT

Representing Florida Engineering Society

ARTHUR B. HALE — PETER KENDRICK
J. E. WALKER — JOSEPH WEIL

Representing American Society of Civil Engineers

A. F. HARLEY

Local Committee on Arrangements

ROBERT M. ANGAS, *Chairman*

ALEXANDER BREST — M. R. PROTHEROE
A. H. BROWN — J. F. REYNOLDS
J. A. LONG — W. E. SHEDDAN
J. B. MORRISSEY — RALPH E. WENDT

Technical Program, Advisory Committee

J. H. DOWLING — GEORGE W. SIMONS, JR.
H. D. MENDENHALL — D. S. WALLACE
EARL NORTH — GILBERT A. YOUNGBERG

Students Committee

P. L. REED, *Chairman*

T. M. LOWE — W. L. SAWYER

Exhibits and Displays

L. A. MURR, *Chairman*

C. E. RICHHEIMER — W. E. SHEDDAN

The Jacksonville Engineering Professions Club, cooperating with the Florida Section of the American Society of Civil Engineers and with the Florida Engineering Society, has kindly offered to handle the non-technical details of the Spring Meeting and has appointed the following committees to handle the work:

Executive Committee

A. H. BROWN, *President* — J. GRANT WILSON, *Vice-President*
M. R. PROTHEROE, *Secretary* — ARTHUR N. SOLLEE, *Treasurer*
RALPH W. COOPER, JR.

Finance Committee

GEORGE B. HILLS, *Chairman*

ALEXANDER BREST — ARTHUR N. SOLLEE

Excursions Committee

J. O. JACKSON, *Chairman*

J. B. MORRISSEY — J. N. WHITFIELD

Hotels and Reservations Committee

JOHN F. REYNOLDS, *Chairman*

EARL Q. MARTIN — L. H. MASTEN

Entertainment Committee

RALPH W. COOPER, JR., *Chairman*

MARTIN S. FABIAN — W. B. SIMMONS

Registration Committee

J. A. LONG, *Chairman*

FRED E. BOSTON — RUSSELL H. DEGROVE
R. A. CHASE — W. AUSTIN SMITH

Information Committee

GERALD M. KEITH, *Chairman*

E. ELLIS BENTLEY — BERKELEY BLACKMAN

Ladies Committee on Arrangements

MRS. ROBERT M. ANGAS, *Chairman*
MRS. GILBERT A. YOUNGBERG, *Co-Chairman*
MRS. A. H. BROWN, *Secretary*

Honorary Members

MRS. C. S. HAMMATT and MRS. W. N. MCDONALD
MRS. FRED MCCONNELL and MRS. FRED NOBLE, *Representing Garden Club of Jacksonville*

Members

MRS. A. D. BENTLEY	MRS. C. F. LOVAN
MRS. E. ELLIS BENTLEY	MRS. MERLE B. MANN
MRS. BERKELEY BLACKMAN	MRS. HERBERT D. MENDENHALL
MRS. WM. T. BROWN	MRS. L. A. MURR
MRS. LEO BURNET	MRS. EARL NORTH
MRS. GEORGE F. CATLETT	MRS. ARTHUR F. PERRY, JR.
MRS. CHARLES J. CARROLL	MRS. J. R. PEYTON
MRS. A. R. COGSWELL	MRS. H. L. PONDER
MRS. L. Y. DYRENFORTH	MRS. M. R. PROTHEROE
MRS. I. B. EARLY	MRS. JOHN F. REYNOLDS
MRS. RAY EDWARDS	MRS. CHARLES E. RICHHEIMER
MRS. E. R. HAMMATT	MRS. H. F. RINGELING
MRS. D. R. HERBERTSON	MRS. C. C. SCHRONTZ
MRS. GEORGE B. HILLS	MRS. GEORGE W. SIMONS, JR.
MRS. R. W. HUNTER	MRS. W. AUSTIN SMITH
MRS. C. V. IMESON	MRS. ARTHUR N. SOLLEE
MRS. JNO. O. JACKSON	MRS. JEFF B. SPOTTSWOOD
MRS. GERALD M. KEITH	MRS. RALPH E. WENDT
MRS. J. A. LONG	MRS. J. N. WHITFIELD

MRS. D. E. YOUNG

The program as a whole has been prepared under the direction of the Committee on Regional Meetings, composed of L. F. BELLINGER, *Vice-President, Am. Soc. C.E., Chairman;* and J. A. ANDERSON, E. P. ARNESON, R. P. DAVIS, L. L. HIDINGER, and T. KEITH LEGARÉ, *Directors, Am. Soc. C.E.*

Please call on the Local Committee on Arrangements or on the Secretary's office for any service desired.

SOCIETY AFFAIRS

Official and Semi-Official

Progress on Salary Studies

The Society's Committee on Salaries has been making extensive studies, with periodic reports to the Board of Direction, the latest at the January 1938 meeting. By order of the Board, this brief résumé of accomplishment has been authorized for publication.

To assist the committee, the Society's 61 Local Sections have been solicited, and as a result 37 advisory committees have been formed. Intensive technical assistance is also being secured from the engineering firm of Griffenhagen and Associates, Chicago, Ill., on a consulting basis.

The committee visualizes its requirements as:

1. To work out a classification plan applicable to any one of 100,000 positions in the civil engineering profession; and
2. To set up a schedule or plan of compensation for salaried positions that will appropriately fit into the classification, thus in effect making available a salary recommendation, equitable for at least the very great majority of those in the profession.

To secure this result the committee frankly recognizes it should include positions of every imaginable type, differing in the field of specialization, zone of interest, burden of responsibility, or degree of expertness required. In line with the specific request of the Board, it expects that the main framework of its classification will be a series of levels or grades carried across the whole field and distinguished one from the other in a similar manner to that of the federal classification. The committee proposes to amplify these data, however, by defining the grades not only objectively but in terms of qualifications, education, experience, knowledge, skill, and other attributes, these factors to be supplemented by a series of "illustrative examples," taken from the main subdivisions of the profession or from typical kinds of organizations. These methods are expected to cover 80 to 90 per cent of the kinds of positions in the profession.

Through the Local Section advisory committees, the work of the Committee on Salaries is being definitely related to the members at large. Already the results of such cooperation have been very gratifying. In particular it is hoped that these committees will be invaluable in supplementing the regular work by filling out thin places in the coverage of this large field. As a further logical development, these advisory committees will have an important function when the grading plan and examples are completed, namely, to pass upon a number of specific questions and thus aid in avoiding misconceptions and apparent differences of opinion. It is planned that the technical staff of the main committee or its consultant will personally meet with as many of the Local Sections as possible.

The Committee on Salaries looks beyond the mere statistical presentation of salaries now being paid; it anticipates a recommendation of the rates that should be paid if civil engineering work is to be adequately recognized. The committee consists of E. P. Goodrich, chairman; A. B. McDaniel, vice-chairman; E. O. Griffenhagen and Arthur Richards. During the past year, Director Herman Stabler has been contact member for the Board; Director J. E. Root is the newly appointed contact member.

St. Louis Group Celebrates 50th Anniversary

The Golden Anniversary of the local organization that later became the St. Louis Section of the Society was celebrated with a banquet meeting in St. Louis, Mo., on February 28, 1938. The outstanding entertainment feature was a reenactment in costume (including "facial spinach," says the reporter) of the first meeting of the group. The sketch was built up by William Flewellyn Saunders, Jr., Assoc. M. Am. Soc. C.E., from early minutes, newspaper files, and files of engineering periodicals.

The dialogue included amusing references to cable cars, which one of the members seemed to think were "not so satisfactory as the old-fashioned mule," and to telephones, which the same conservative engineer thought might some day have a limited use in business, "though never as a substitute for messenger boys." The latter remark led another member to point out that telephones were

St. Louis Section Harks Back to the Horse-and-Buggy Days
Left to Right: L. A. Pettus, as Thomas Whitman, Brother of the Famous Poet; Clarence Ax, as S. Bent Russell; John B. Dean, as M. L. Holman; S. Clay Baker, as Henry Flad; R. B. Brooks, Jr., as J. B. Johnson

at that very time being used to speed construction on one of the greatest engineering projects of the day—the Forth Bridge in Scotland. An under-water cable, he reported, maintained communications between shops and offices at opposite ends of the job. In the accompanying illustration John B. Dean, masquerading as M. L. Holman, one of the charter members, is reading a paper on the Chain of Rocks Water Works, which was in process of construction in 1888.

The program also included a speech in more serious vein by Willard T. Chevalier, M. Am. Soc. C.E., emphasizing the mechanical progress of the past fifty years.

The St. Louis Section made a distinct effort to bring to this meeting members assigned to it by the recent act of the Board of Direction but not heretofore affiliated with the Section. A special letter was written to these, with an advance copy of the program and menu. The result was an attendance of some two hundred members and guests, whose enthusiasm could be gaged by the large number who remained for conversation or dancing until long after the meeting was declared adjourned.

A brief sketch of the early activities of the St. Louis organization was published on page 131 of the February issue of Civil Engineering.

Scholarship in Civil Engineering Offered by Columbia University

In honor of Horatio Allen, fifth President of the Society, a member of the class of 1823 at Columbia University, New York, N.Y., a scholarship in civil engineering has been established there. It covers tuition fees to the amount of $380 a year and is open to students who can submit credits covering at least the first two years in an accredited engineering school.

This scholarship is now open for the year 1938–1939. It may be held by the successful candidate for from one to three years, depending upon the class which he enters at the University. His record must be approved by both a committee of the Society and by the Dean of the Engineering Schools, Columbia University.

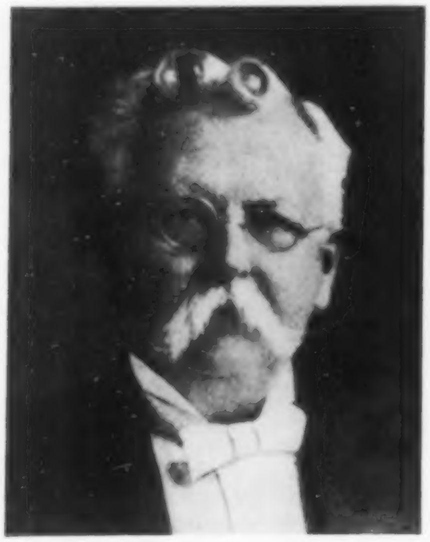
All necessary details, and instructions as to the form of application will be supplied on request to Society Headquarters.

John Alexander Low Waddell

HON. M. AM. SOC. C.E.

1854–1938

After a lifetime of activity that made his name prominent throughout the United States and in the Orient as well, J. A. L. Waddell, Hon. M. Am. Soc.C.E., died in New York City on March 3. He was just past 84 years of age and had been active in mind and body up to the time of his last illness, which followed a stroke in November 1937.



JOHN ALEXANDER LOW WADDELL

Upon graduation he taught at his alma mater, Rensselaer Polytechnic Institute, for some time. Prior to his college course, he had taken a trip to China as a passenger on a clipper ship. Thus with an early interest in the Orient, he went to Japan in 1882 and there served four years as professor of civil engineering in the Imperial University at Tokyo. Many years later he returned, being called twice to China by its government, in 1921 as member of an international commission studying a proposed bridge over the Yellow River, and in 1929 as consulting engineer to the Ministry of Railways.

Continuously from 1886 he was in the active practice of bridge engineering as consultant, first in Kansas City until 1920, and then in New York City until his death. Many large and important structures over the Mississippi, Missouri, and Hudson rivers, others in the New York metropolitan district, and a number in Canada, Mexico, Europe, and New Zealand, were monuments to his genius. In particular he is known for the development of the modern lift bridge, of which he was the originator. The last of this type under his direction was the Marine Parkway Lift Bridge, a 540-ft span, over Rockaway Inlet, in New York City.

He was honored not only in his own country but by the governments of Japan, Russia, China, and Italy. He also held five honorary doctorates, including one from Japan, one from Canada, and one from Puerto Rico. Continuously throughout his life he wrote engineering books and monographs. In his technical writings as in his work, Dr. Waddell emphasized the principle of economics. On three separate occasions he was recipient of the Norman Medal of the Society, in the last instance in 1920. Thus he was a living example of his own ideal, that every engineer should disseminate his technical findings to other engineers, in order to repay in part his obligations to the profession.

Dr. Waddell worked hard and he played hard. Each winter it was his habit to spend several weeks at his favorite sport, deep-sea fishing in tropical waters.

His many and varied accomplishments were given added recognition when in 1936 he was elected Honorary Member of the Society. A full account of his many professional associations, his long technical activities throughout the world, and his numerous contributions to the advancement of his profession, will doubtless be included in his official memoir when it is published by the Society.

1938 Year Book Issued with April "Proceedings"

APPEARING as Part 2 of the April PROCEEDINGS and being mailed to each member on the fifteenth of the month, the 1938 Year Book will be of interest to everyone associated with the Society. No Year Book is up to date; as soon as the issue is out, there have already been changes of address which were received too late for inclusion. Even so, the new Year Book is always infinitely more useful than the old one, and this applies especially to the current edition.

All corrections of address, title, or Society grade have been included up to March 1, 1938. The number of such changes is startling. There were 8,200 post cards returned for Year Book entry during the months of December 1937 and January and February 1938. Compared with the same months a year previous, this represents an increase of 33 per cent. These figures do not include changes received by correspondence, but only those received on the special post-card form sent to each member December 1, 1937. Further, it is not intended to infer that the changes made in each instance required a complete revision of existing records.

To assess the economic significance of this 33 per cent increase is difficult; both favorable and unfavorable aspects are doubtless present. But as far as it concerns the Year Book the situation furnishes graphic proof of the value of the present issue.

At the same time it throws an interesting light on the extensive work required at Headquarters to include such an unprecedented quantity of changes. For weeks the staff has been compiling, checking, rechecking, and proofreading. Both the alphabetical and geographical lists are involved and the utmost care is taken to insure accuracy. The regular statistics for the Year Book also require attention. It will therefore be appreciated that the task of getting out the 1938 Year Book is not simple.

Some innovations have also been included this year. For the first time, the Annual Report of the Board of Direction appears here and not elsewhere. This has the definite advantage of making this important record continuously available to members. Of special interest to Local Sections will be the new map indicating the official boundaries of the various Sections.

Following the custom for many years, the color of the cover has been changed. The present issue is in blue, to distinguish it from the red cover of 1937. This year in particular it is advisable to file or destroy the red 1937 Year Book and substitute in its place the blue volume for 1938.

Kentucky Adopts Registration Law for Professional Engineers

KENTUCKY became the thirty-ninth state to adopt a registration law for professional engineers when the governor signed a bill on March 11, 1938. It will become effective June 9, 1938. The new law closely follows the Model Registration Law sponsored by the American Society of Civil Engineers and many other engineering societies.

Papers Filed in Library

ATTENTION is called to the following papers, which have been contributed to the Society for filing with the Engineering Societies Library, 29 West 39th Street, New York, N.Y. Charges for photostating will be quoted by the latter organization on request.

SUSPENSION BRIDGES

HARDESTY, SHORTRIDGE, M. Am. Soc. C.E., and WESSMAN, HAROLD E., Assoc. M. Am. Soc. C.E., "Preliminary Design of Suspension Bridges." This paper, with the exception of the extensive computations, was published in PROCEEDINGS for January 1938. It is now on file, complete, in the Library. It comprises a total of 85 pages of text, computations, and drawings.

OUTLINE FOR HYDRO-ELECTRIC INVESTIGATION

KING, C. G., Jun. Am. Soc. C.E., "Planning a Hydro-Electric Investigation" (18 pages of text—about 5,400 words—plus 25 pages of report outlines and forms). The purpose of this paper is "to present a standard method for planning and laying out investigations," which is "sufficiently flexible to be capable of application to the whole field of water control planning."

COLORADO RIVER DEVELOPMENT—SILT PROBLEM

LAURGAARD, O., M. Am. Soc. C.E., "Development of the Lower Colorado River" (27 pages—about 7,500 words—and 2 charts). The first half of this paper traces the course of development of the

lower Colorado River since the construction of the Laguna Dam, describing briefly such projects as Boulder Dam, Parker Dam, Imperial Dam, and the All-American Canal. The second half is given over to a discussion of the silt problem, with particular reference to the possibility of bed degradation below the dams. The paper was originally presented before the Knoxville Technical Club in June 1936.

Wharf Repairs

Miller, Maj. R. L., "Repairs to the Substructure, Army Base, Boston, Mass." This paper was presented at the 1937 Fall Meeting of the Society and was summarized in the December 1937 issue of Civil Engineering. The complete manuscript consists of 16 single-spaced typewritten pages, plus 22 pages of illustrations.

Concrete Dam Design

Nelidov, I., Assoc. M. Am. Soc. C.E., "Stability Design of Concrete Dams," (28 pages—about 9,500 words). In the design and checking of concrete dams, says the author, relatively little attention is given to investigating the conditions of stability. It is his intention "to present a detailed investigation of the influence of various stress distributions on the factors of safety of concrete dams in shear-sliding and of bond stresses in foundation on safety in overturning."

Non-Technical Phases of Engineering Discussed in E.C.P.D. Report

Noting the trend in the extension of engineering far afield from old-time technical confines, the Engineers' Council for Professional Development in its fifth annual report predicts a future which will call more and more upon the engineer for aid in solving its accumulating non-technical problems. The real contribution of engineering to non-technical fields, it is pointed out, is the "engineering method" of scientific approach for the solution of economic and social problems. Furthermore, the public does not understand the significance of technological changes in producing the more abundant life, nor does it appreciate that the achievements of the engineer are products of a scientific method, which may result in achievements in other fields as well. The report suggests that the work of better acquainting the young engineer with the non-technical phases of engineering be emphasized by E.C.P.D., whose member bodies comprise 7 national engineering societies.

Developing a system whereby the progress of the young engineer towards professional standing can be recognized by the public, by the profession, and by the man himself, E.C.P.D., through standing committees on student selection and guidance, accrediting (approval) of engineering curricula, professional training, and professional recognition, aims to coordinate and promote efforts and aspirations directed towards higher professional standards of education and practice, greater solidarity of the profession, and greater effectiveness in treating technical, social, and economic problems.

The work of E.C.P.D. in accrediting engineering curricula is outstanding. In no other profession has the inspection of curricula and courses been carried out in so orderly a fashion and with so much expedition, and in attacking the problem of "selection of freshmen" there was no precedent to follow—other professions draw men directly from the colleges, while the engineering profession draws its students from high schools. To cull some 20,000 prospective engineering freshmen from hundreds of thousands of seniors, in thousands of high schools, for entrance to 150 engineering schools, is a difficult task. Upon it, however, depend the careers of individuals, the efficacy of engineering schools, the quality of the engineering profession, and its contribution to the interests of the general public.

Since the accrediting program was inaugurated in 1935, a total of 134 degree-granting engineering schools have submitted 645 curricula to E.C.P.D. for accrediting. Of this number, 129 institutions have been visited to date and recommendations prepared on 626 curricula, as follows: To accredit, 374; to accredit provisionally for a limited period, 71; to defer action, 8; and not to accredit, 173. At present there is every indication that the accrediting program will result not only in a generally accepted accredited list, for which there is a real need, but also in a definite stimulation to higher excellence in our engineering schools, and a wide distribution among the institutions, particularly among the officers of administration, of some of the best ideas in engineering education.

The crux of the entire program of professional training lies in the development of training material for junior engineers and in the formation of Junior Groups. While it is conceded that the immediate focus of interest of the junior engineer is his job, E.C.P.D. feels that very serious consideration must be given to the long-range task of developing professional engineers in the broadest sense of the term. The assistance on problems of the job is definitely a responsibility of the local sections of the national societies. A tangible measure of assistance can be given by the local groups of engineers in acquainting the juniors with the provisions of the licensing law of their particular state and in organizing means of preparing qualified individuals to pass examinations or otherwise to meet the legal requirements.

The present main objective of the E.C.P.D. is the development of the young engineer for his subsequent career. In his choice of engineering and in the schools of learning and of experience there should be proper balance of the technical and non-technical. It is of first importance to get engineering in true perspective in relation to life in general, so that the development of the individual may be well balanced. As he visions the larger goal he may realize his need for a broad preparation, both technical and liberal, for mastering principles as well as developing skills, for acquiring a method as well as to think and to deal with men as well as with things, for preparing to be a leader in the future by being a leader now, for sensing the changing function of his profession in our changing world and cultivating attitudes which differentiate the engineer-manager, the engineer-administrator, and the engineer-citizen from the purely technical engineer.

Copies of the E.C.P.D. report have been distributed by the Society to the secretaries of all Local Sections, to the Faculty Advisers and Contact Members of all Student Chapters, and to members of various committees. Others interested can obtain the report from the offices of E.C.P.D., at 29 West 39th Street, New York City.

"Aims and Activities"—New Edition

The 1938 edition of the Society booklet "Aims and Activities" will be available for distribution during the latter part of April. This year, however, there will be a change in the mailing plan. Copies will not be distributed to the entire membership as was done last year, as it is felt that the information added since the 1937 edition was published does not justify this expense. Copies will be available, however, to any member upon request.

In addition to the list and photographs of the 1938 Society officers, there will be the usual pages devoted to the history and government of the Society, meetings, publications, and the medals and prizes awarded annually. Additional pages review the activities and personnel of the Technical Divisions, give details regarding Local Sections, the Code of Ethics, membership, and the requirements for admission, and furnish information regarding the Employment Service and the Library. The committees of the Board of Direction are listed as are the names and addresses of the presidents and secretaries of the Local Sections; and a complete list of the Student Chapters, together with a map showing the locations of the Local Sections and Student Chapters, is included, with a new map giving the boundaries of each Local Section. Practically all this information is contained also in the 1938 Year Book to be issued on April 15.

Copies of "Aims and Activities" are forwarded to each new member of the Society and to the Student Chapters of the Society. Any member interested in securing a copy is requested to write to the Secretary.

In This Issue . . . .

Early Presidents of the Society

XXV. George Shattuck Morison, 1875–1903

President of the Society, 1895

THE CAREER of George Shattuck Morison presents another interesting example of the man who, possessing the creative instinct and a preference for an active life, turns to engineering after an earlier training for another profession. It is also remarkable in that after one or two brief years of apprenticeship he became one of the foremost American engineers and built ten bridges over the Missouri, five over the Mississippi, and one over the Ohio River—surely a great accomplishment for one career.

GEORGE SHATTUCK MORISON
Twenty-Fifth President of the Society

George Shattuck Morison was born in New Bedford, Mass., December 19, 1842. Most of his boyhood was passed at Milton, near Boston, where he developed a faculty for surveying and architecture. He was graduated from Harvard University with the degree of bachelor of arts in 1863 and three years later he received a degree in law from the same institution. He was admitted to the bar in New York and worked with the famous firm of Evarts and Choate, but within a year had decided to abandon law for engineering. He began work in 1867 on the bridge over the Missouri River at Kansas City then being erected by Octave Chanute. He followed Chanute to the Erie Railroad in 1873, as resident engineer of the Eastern Division. The Erie at that time was chiefly equipped with wooden bridges; the few that were of iron were proportioned for much lighter loadings than those of the new locomotives it was intended to put on the line. Morison accordingly had an ample field for his tastes and talents in reconstructing and strengthening the bridges. He soon became the principal assistant engineer, and when the celebrated Portage Bridge burned down in 1875, he designed and built the iron structure that took its place, within six weeks of the fire.

Morison's structure has since been replaced by a heavier bridge, but the Portage Viaduct over the Genesee was one of the first of the metal-viaduct tower type which became a standard form of American viaduct construction. There were three deck-truss spans of about 50 ft, two of 100, and one of over 118 ft, supported at a maximum height of 235 $^1/_2$ ft above the valley bottom. Only 655 tons of iron were used in the structure, and the cost, including the oak floor, was about $100,000. The columns and struts, built up of rolled plate and angle sections of iron with lattice bars, were of the typical form that was evolved in American practice and differed little from modern steel construction.

Morison resigned from the Erie in 1875, and until 1880, when he became a consulting engineer, was a partner in the firm of Morison, Field and Company, bridge contractors. The first of the great bridges which made his name famous was that over the Missouri at Plattsmouth, finished in 1880. It had two 400-ft spans and was about half iron and half steel in construction. Morison's description as to how this steel was made is included in his monograph on the Plattsmouth Bridge and is a bit of interesting history of the early development of the manufacture of structural steel.

The Plattsmouth Bridge was followed by the bridge over the same river at Bismark, N.Dak., finished in 1882; a third, at Blair, Nebr., was begun the same year. The pneumatic foundations for the Plattsmouth and Bismarck bridges had been sunk under contract by people more or less familiar with such work. At Blair, however, Morison decided to do the pneumatic work himself by day work under experienced foremen, as thereby he could control the work better and use such safety appliances as were not likely to be used by the contractors. Also he hoped to achieve some considerable economy. The work proved so successful that he adopted this plan at nearly all subsequent bridges where pneumatic foundations were required. These came in such succession that he was able to transfer the pneumatic plant from one to the other, and eventually a very fine pneumatic plant was developed at a comparatively small cost to any one bridge.

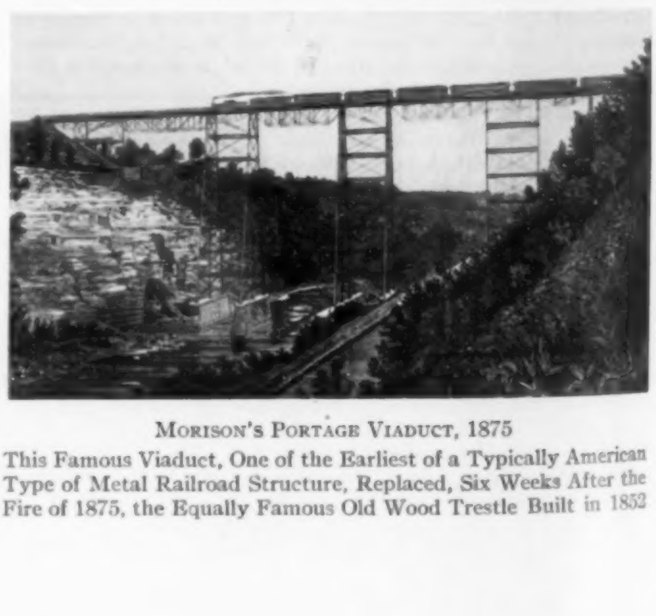
While these bridges were building, Mr. Morison constructed two bridges on the Pacific slope—that over the Snake River at Ainsworth, Wash., in 1883; and that over Clark's Fork of the Columbia, near Belknap, Mont., in 1884.

Up to this time the superstructure of Mr. Morison's great bridges had been made partly of iron and partly of steel, the floor, intermediate posts, and laterals being of iron, the remainder of steel. In his next Missouri River bridge, completed in November 1888, at Sioux City, iron was used only in members requiring welding; the remainder of the superstructure was of steel, either open-hearth or Bessemer. All Mr. Morison's subsequent bridges of large size were built practically entirely of steel.

From 1887 to 1889 he was in partnership with E. L. Corthell, M. Am. Soc. C.E. Bridges built by the partnership included the Sioux City Bridge just mentioned, another over the Missouri at Nebraska City, and the famous bridge over the Ohio at Cairo, Ill.

The latter is a most interesting example of the speed of American bridge erection and the advantages of the pin-connected type of truss. Cooper pointed out in 1889 that the 7,000 iron truss railroad bridges of spans over 100 ft then built in the United States were all of the pin-connected type. In English practice, however, solidly riveted girder types predominated. A great controversy raged over the relative advantages of these two types. In the end it became clearly recognized that economic conditions in America and abroad were radically different and the type of design best adapted to these conditions would prevail. In America, with long spans over swift rivers, with high costs of labor and capital, and with the necessity for rapidly completing the structure so it could be quickly put in service, thus insuring a rapid turnover of capital for the contractors and early dividends for the owners, the pin-connected bridge was the best type. The fully riveted bridge, although perhaps more solid and rigid, took a long time to erect, whereas the pin-connected truss was shipped in small pieces, easily transported over the long distances often involved in work in the United States, and could be erected in such a brief space of time that European engineers refused to believe the statements of American engineers on this subject.

The Cairo Bridge involved two channel spans 61 ft deep and 518$^1/_2$ ft long, with the floor over 100 ft above river level. The trusses had, of course, to be supported by falsework while they were being erected. The first truss was erected in 6 days. The supporting wood falsework was then removed, the supporting piles pulled from the river, driven again for the next span, falsework reerected on them, and the second span completed 33 days later, including



MORISON'S PORTAGE VIADUCT, 1875

This Famous Viaduct, One of the Earliest of a Typically American Type of Metal Railroad Structure, Replaced, Six Weeks After the Fire of 1875, the Equally Famous Old Wood Trestle Built in 1852

5 days lost waiting for the masonry work to be finished. Such a record would have been impossible with any other type of structure.

Before the Cairo Bridge was finished Morison had begun his greatest structure—the Memphis Bridge, opened in 1892. Unfortunately the U. S. War Department insisted that the greatest span of this bridge be on one side, and it is a most disappointing structure from the esthetic standpoint—and with no reason that is clearly apparent to the observer. Beginning with a 225-ft anchor arm it spans the main channel with a 790-ft cantilever and suspended span, followed by two 621-ft spans (center to center of bearings) built as continuous trusses. At the west end there is a short deck span and a viaduct approach about a half mile long. With the exception of the suspended span, the entire structure—trusses, anchor, and cantilever arms—was erected on falsework 110 ft high above the river. One of the controlling features of this work was the matter of foundations. The two river piers were in water some 40 ft deep, and their pneumatic caissons had to be sunk to a depth of 102 ft. But Morison, like Eads, had had ample experience with the shifting sands and currents of great rivers, and this case proved no exception in his list of triumphs in difficult river and foundation work. While it is a remarkable piece of steel work—nine companies furnished the 8,000 tons of steel used and it ranked next to such works as the Forth Bridge in size—it is also a forceful reminder of the fact that a truly great structure built with a total disregard of esthetic standards will always remain unsatisfactory and incomplete—it is great only because of its bigness.

To complete the list of Morison's important bridges, mention must be made of those over the Mississippi at Winona, Minn. (1891), Burlington, Iowa (1891), and Alton, Ill. (1892–93); and those over the Missouri at Leavenworth, Kans., and Bellefontaine Bluffs, Mo. (1892–1893).

Morison served as a member of the Panama Canal Commission from 1899 to 1903. He threw himself into the study of the situation with determination. He went to Paris and ransacked the archives of the Panama Canal Company; he exhausted the sources of actual information in America; and he went (with other members of the Commission) to Nicaragua and the Isthmus and examined the ground. There were those who said that he sought the glory of identifying his name with some route other than the two which had come to be accepted as the only practicable ones. This would not have been an ignoble ambition; but his passion for thoroughness is a sufficient explanation of his reluctance to make up his mind. When he decided in favor of the Panama route he had canvassed the matter so completely that no doubt remained, and he could speak with the conviction and power of knowledge. Apart from his work with the Commission, he delivered a number of addresses before general audiences, which had much weight in making the choice of the Panama route acceptable, or even possible.

Among Morison's writings special mention should be made of *The New Epoch as Developed by the Manufacture of Power*, a small book of 135 pages which has become a classic of engineering literature. It was compounded from his presidential address to the Society and a Phi Beta Kappa oration at Harvard. To Morison all engineering other than military was civil engineering, and in *The New Epoch* he outlines his thoughts and reflections on the new epoch which he saw developing as a result of the discovery and utilization of mechanical power. The book shows the depth and originality of his thought; it reveals his capacity for high conceptions and powerful generalizations and expresses his constitutional aversion to many words. The fundamental idea running through the book is that mankind was then entering on a new ethnical period, and he develops this thought in considering various forms of social organization and activity. His observations have been strikingly confirmed by the events of the first third of the twentieth century.

Thus this young lawyer, with no special engineering training, entering the engineering profession at the age of 25, was quickly recognized as a master mind. Nature had endowed him with a strong intellect and a capacity for work. The minutest detail was not too small to be worked out carefully and thoroughly, yet he never lost that grasp of the work as a whole so essential to progress and success. One of his rules was, that, having five minutes to give to a problem, he would spend three in thinking it out and the remaining two in doing it.

Nature had endowed him with a strong will, which made him a difficult man to work with. Himself an indefatigable seeker after truth, he expected his staff to be no less energetic, accurate, and conscientious than he, and an indolent or slovenly worker did not remain long in his service. In his attitude toward his fellow man, he belonged to that school of thought of which Herbert Spencer was the most conspicuous representative in modern times. As a matter of principle, and for the ultimate good of society, he would have made every man help himself to the utmost of his power. And yet he did help many with his counsel and his money when he had satisfied himself that they were worthy.

Beneath his gruff and almost uncouth exterior was a characteristic not evident to those who knew him only superficially. With all his strength and self-reliance he was a very modest man. In matters where experience had not taught him that he was strong, he was apt to distrust his own judgment; self-reliance with him was largely a product of reason.

Morison never married. His death occurred on July 1, 1903. In addition to the honor conferred on him by the Society, he held the distinction of being a Telford Medallist of the Institution of Civil Engineers (Great Britain). He had also been a trustee of the Western Society of Civil Engineers and a member of both the American Society of Mechanical Engineers and the American Institute of Mining Engineers.

[The greater part of this sketch has been taken verbatim from material prepared by James K. Finch, M. Am. Soc. C.E., and from the Memoir of Mr. Morison that was published in Transactions, Vol. LIV.]

Don Johnstone Becomes Editor of Civil Engineering

With the current issue, the editorship of Civil Engineering is being taken over by Don Johnstone, Jun. Am. Soc. C.E., who was previously for three years an assistant editor of the Society with miscellaneous responsibilities. His work is now being expanded to include not only those departments he had previously handled but the general editing of the publication.

Following his graduation from the University of Illinois in 1931, Mr. Johnstone was employed at the U. S. Waterways Experiment Station in Vicksburg, at the Bureau of Reclamation in Denver, and at the U. S. Engineer Office in Kansas City, from which he came to the Society in 1935. He was editor-in-chief of his college engineering magazine, the *Technograph*, which experience has been supplemented with editorial duties at Vicksburg and at Society Headquarters. As an undergraduate he was also elected to Chi Epsilon, honorary civil engineering society, and to Tau Beta Pi.

Since coming to New York, Mr. Johnstone has interested himself in the Naval Reserve, and now holds a reserve commission as lieutenant (jg) in the Civil Engineer Corps. He has also been active in the Junior group of the Metropolitan Section and is at present serving a term as chairman. The family includes Mrs. Johnstone, who is also an Illinois graduate, and two small boys. They live in Plainfield, N.J.

In and About the Society

Here is a record that any Contact Member of a Student Chapter may well be proud of: E. L. Durkee, since 1934 assigned to the Chapters at Lehigh University and at Lafayette College, is credited with almost perfect attendance at the sessions of both groups. In addition, he delivers a talk once a year on some phase of structural engineering, and assists the students in securing other speakers.

* * * *

"The Past-Presidents of Your Detroit Section" is the caption of a mimeographed bulletin recently distributed to members of that Section by L. C. Wilcoxen, Assoc. M. Am. Soc. C.E., its secretary. Designed to make the members better acquainted with their former leaders, the bulletin tells something of the accomplishments of each of the 19 men who have held that position since the organization of the Section in 1916. Letters from five past-presidents now in other parts of the country add a personal touch to the sketches.

* * * *

A tentative schedule of minimum fees for engineering services applicable to the city of Syracuse, N.Y., has been prepared by the Syracuse Section and sent to the members for criticism and suggestion. Another current activity of the same Section is the promoting of a series of radio talks describing what engineers are doing in state, county, and city affairs. The series has been tentatively accepted by a local broadcasting station.

Sources of Income in the Engineering Profession 1929 to 1934

This is the concluding article of a series of seven covering the results of the survey of the engineering profession made in 1935 by the Federal Bureau of Labor Statistics at the request of the American Engineering Council. It is abstracted from a report by Andrew Fraser, Jr., of the Labor Bureau, entitled "Annual Income in the Engineering Profession, 1929–1934; Part 2—Sources of Income."

Previous articles of this series were published in "Civil Engineering" in August 1936 and in February, May, June, September, and December 1937. The complete final bulletin is now in preparation by the Federal Bureau of Labor Statistics and when completed will be issued for sale by the Superintendent of Documents, Washington, D.C.

THE earned annual income data used in the analysis summarized in CIVIL ENGINEERING for September 1937, were those reported for personal services of all classes of engineers, irrespective of whether they were engaged primarily in engineering or non-engineering work. In the present analysis, distinction is made between the two types of employment. On the questionnaires, income was reported for the full years, 1929, 1932, and 1934, but the type of employment was reported only as of the end of each year. Consequently, in making the present study, it has been necessary to assume that the kind of engineering or non-engineering employment engaged in at the end of the year was the source of the income for that year.

In 1929 there was greater spread in the earnings of engineers engaged in non-engineering work than in those obtained from engineering work. Thus, among engineers 40 to 47 years of age, 10 per cent of those engaged in non-engineering earned more than $12,424 and 10 per cent earned less than $2,420 per year; while the respective annual incomes of similar proportions of all those engaged in engineering work were $9,615 and $2,705; and of graduates in engineering $10,088 and $2,936. Data for all age groups are presented in Table II.

It will be noted that the age of maximum earning power for engineers arrives more quickly for non-engineering than for engineering work. However, at 48 to 55 years of age those college graduates who stayed in engineering were doing as well as those who had gone into non-engineering work. This was true even at the highest income levels.

Despite the fact that in 1929 the tendency was for average annual incomes of engineers engaged in non-engineering to exceed slightly those from engineering work, the opportunities in the former field did not embrace more than 7 per cent of the total in any one age classification.

Only at the lowest 10 per cent income group or level in 1929, did engineering incomes exceed those from non-engineering work at all ages for which comparison can be made (Fig. 1). At the middle levels the engineering incomes were greater than non-engineering by only 10 per cent at 25 and 27 years of age, and by only 5 per cent at age 30. From this point the more rapid advance in average non-engineering earnings to a maximum at age 44 brought about an equalization of the incomes near to age 34 at a value of $3,700 per year. They again equalized at 54 years. At the upper 10 and 25 per cent income groups or levels engineering work ceased to have an advantage over non-engineering near to age 26. However, the steady advance in engineering earnings after that age, together with the declines in non-engineering earnings, brought about an equalization of incomes at age 58.

Over the period 1929–1934 the relationship changed between the jobs engineers took in engineering and non-engineering work. On the whole it appears that in 1929 non-engineering work was an alternative to engineering work, but from 1929 to 1934 many non-engineering jobs were accepted as an alternative to unemployment or work relief.

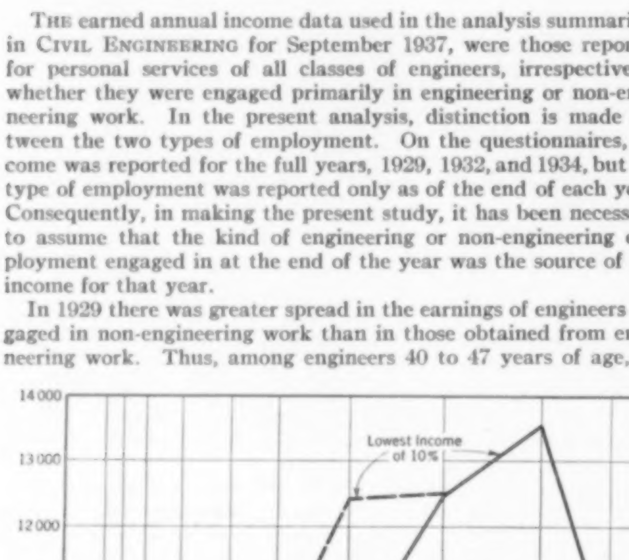


FIG. 1. EARNED ANNUAL INCOME OF PROFESSIONAL ENGINEERS, BY AGE, IN 1929

The Solid Lines Indicate Income of Engineers Engaged in Engineering Work; the Dotted Lines, Income of Engineers Engaged in Non-Engineering Work

TABLE I. COMPARISON OF 5 LEVELS OF EARNED ANNUAL INCOME IN 1932 AND 1934, FOR ALL ENGINEERS REPORTING UNEMPLOYMENT, ON AN AGE BASIS

(Without Regard to Type of Education)

Age in Years	Year of Graduation	Years After Graduation	Proportion Earning More Than Specified Amount: 10%	25%	50%	75%	90%
					1932 Income		
67 & over . .	Prior to 1889	44 & over	*	*	*	*	*
59–66 . . .	1889–96	36–43	†	†	$ 720	†	†
51–58 . . .	1897–1904	28–35	$2,453	$1,477	793	$396	$159
43–50 . . .	1905–12	20–27	2,790	1,867	1,105	528	211
39–42 . . .	1913–16	16–19	2,497	1,574	1,008	494	198
35–38 . . .	1917–20	12–15	2,420	1,417	1,057	559	223
31–34 . . .	1921–24	8–11	2,150	1,416	932	462	185
29–30 . . .	1925–26	6–7	1,754	1,250	761	380	152
27–28 . . .	1927–28	4–5	1,690	1,178	751	375	150
26	1929	3	1,232	925	605	303	121
25	1930	2	1,280	907	581	290	116
24	1931	1	1,233	891	588	294	118
20–23 . . .	1932	0	‡	754	503	251	‡
					1934 Income		
69 & over . .	Prior to 1889	46 & over	†	†	$1,000	†	
61–68 . . .	1889–96	38–45	‡	$1,300	688	$344	‡
53–60 . . .	1897–1904	30–37	$2,349	1,700	1,080	542	$217
45–52 . . .	1905–12	22–29	2,546	1,943	1,357	748	299
41–44 . . .	1913–16	18–21	2,151	1,730	1,357	867	353
37–40 . . .	1917–20	14–17	2,250	1,780	1,316	769	308
33–36 . . .	1921–24	10–13	1,959	1,634	1,304	836	340
31–32 . . .	1925–26	8–9	2,138	1,746	1,243	716	287
29–30 . . .	1927–28	6–7	1,796	1,495	1,045	546	219
28	1929	5	1,805	1,417	893	449	180
27	1930	4	1,638	1,374	948	534	214
26	1931	3	1,545	1,210	836	419	167
25	1932	2	1,548	1,200	716	358	143
24	1933	1	1,460	1,107	756	378	151
20–23 . . .	1934	0	1,257	881	571	285	114

* Less than 10 persons reported. † Between 10 and 50 persons reported.
‡ Between 50 and 100 persons reported.

The extent to which earning opportunities from non-engineering work depreciated between 1929 and 1934 differs at the various age levels. The average earnings of two groups in non-engineering who were 28 to 40 years in 1929 declined by almost one-third from 1929 to 1934. As between the groups that were over 48 years in 1929 the average income of the 1934 group is only one-half the average of the 1929 group. Similarly at each of the other income levels a greater fall is found in the average income of older men in non-engineering.

Those who were able to stay in engineering fared better. Furthermore the changes which occurred in the earnings from engineering work, as reported by all engineers and by graduates only, were consistently uniform.

It was among those newcomers who were trying to force their way into the profession that the greatest fall in income occurred. Thus average earnings in engineering in 1934, two years after graduation, were 37 per cent less than in 1929. The earnings of those who had been out of college 10 years were 31 per cent lower in 1934 than in 1929. At higher ages all groups averaged a decrease of 26 per cent.

In 1934 almost one-tenth of the engineers were unemployed or on work relief at the end of the year. The low level of earnings of this group during 1934 contributed to lowering the average earnings of all engineers. Thus of those engineers who were unemployed at the end of 1934 the average earnings for the preceding 12 months of those who were less than 28 years of age ranged from $700 to $950. Engineers of 40 to 50 years averaged $1,350. Only about 10 per cent of the unemployed, even though they were in those ages at which engineering earnings reached a peak, had made as much as $2,000 in the preceding 12 months.

Caution should be exercised in comparing earnings with various types of employment in 1929, 1932, and 1934. The earnings of all engineers in engineering work reflect best the changes in what was being paid for engineering services. This is not true of the earnings from non-engineering; they indicate merely what individual engineers were able to earn in miscellaneous employments called "non-engineering." Conceivably such persons might all have been managers of industrial establishments in 1929 and gasoline-station attendants in 1932. Further, among those reported at the end of the year as engaged in both engineering and non-engineering, there were some who suffered unemployment during part of the year. Inasmuch as unemployment was far more common in 1932 and 1934 than in 1929, this accounts for part of the decreases in annual incomes previously noted for both engineering and non-engineering.

Income of Engineers Reporting Unemployment

In 1934 almost one-tenth of the reporting engineers were unemployed or on work relief at the end of the year. The distribution of the earnings of this group is shown in Table I. These data have significance only as indicating the income which a group, unemployed in December 1934 (or December 1932), had earned in the preceding 12 months. Some were probably men who had had a few months' work at a good rate, and a long period of unemployment. Others may have worked quite steadily at a low rate and become recently unemployed. All were unemployed at the end of the year. They could look back on average earnings for the preceding 12 months of $700 to $950 if they were less than age 28, while those of 40 to 50 had averaged $1,350. Only about 10 per cent of the unemployed, even though they were in those ages at which engineering earnings reach a peak, had made as much as $2,000 in the preceding 12 months. Ten per cent had made less than $300 a year.

Table II. Comparison of 5 Levels of Annual Earnings from Non-Engineering and Engineering Work Reported in 1929, 1932, and 1934

			Proportion with Annual Earnings of More Than Specified Amount as Derived from—														
			10 Per Cent			25 Per Cent			50 Per Cent			75 Per Cent			90 Per Cent		
			Non-engineering Work	Engineering Work by		Non-engineering Work	Engineering Work by		Non-engineering Work	Engineering Work by		Non-engineering Work	Engineering Work by		Non-engineering Work	Engineering Work by	
Age	Year of Graduation	Years After Graduation	by All Engineers*	All Engineers*	All Graduates	by All Engineers*	All Engineers*	All Graduates	by All Engineers*	All Engineers*	All Graduates	by All Engineers*	All Engineers*	All Graduates	by All Engineers*	All Engineers*	All Graduates
								1929 Income (in Dollars)									
64 years and over	Prior to 1889	41+	†	9,937	10,148	‡	6,917	7,346	2,400	4,476	4,971	‡	3,060	3,469	†	1,957	2,413
56–63 years	1889–96	33–40	†	12,625	13,516	7,155	7,500	7,955	4,400	4,979	5,590	2,893	3,422	3,760	†	2,420	2,624
48–55 years	1897–1904	25–32	12,495	11,709	12,478	7,867	7,108	7,610	5,057	4,912	5,232	3,494	3,481	3,777	2,280	2,661	3,020
40–47 years	1905–12	17–24	12,424	9,815	10,088	8,106	6,407	6,747	5,346	4,562	4,876	3,408	3,405	3,624	2,420	2,705	2,936
36–39 years	1913–16	13–16	10,140	7,751	8,294	6,620	5,680	6,099	4,347	4,102	4,353	3,013	3,210	3,354	1,998	2,582	2,756
32–35 years	1917–20	9–12	8,052	6,480	6,578	5,502	4,814	4,988	3,685	3,672	3,822	2,792	3,010	3,146	1,945	2,458	2,581
28–31 years	1921–24	5–8	5,460	4,753	4,842	4,099	3,776	3,847	3,042	3,145	3,207	2,349	2,577	2,664	1,642	2,150	2,258
26–27 years	1925–26	3–4	4,170	3,618	3,641	3,075	3,104	3,124	2,331	2,558	2,582	1,821	2,164	2,200	1,308	1,850	1,891
24–25 years	1927–28	1–2	2,910	3,043	2,992	2,344	2,501	2,477	1,786	2,105	2,095	1,407	1,834	1,831	889	1,476	1,493
23 years	1929	0	2,496	2,356	2,165	1,973	1,933	1,858	1,500	1,322	1,168	936	888	862	446	502	449
								1932 Income (in Dollars)									
67 years and over	Prior to 1889	44+	†	9,009	9,386	‡	6,032	6,363	3,000	3,846	4,100	‡	2,242	2,460	†	1,145	1,233
59–66 years	1889–96	36–43	†	9,020	9,643	5,000	6,252	6,589	2,550	4,126	4,689	1,200	2,640	3,143	†	1,300	1,571
51–58 years	1897–1904	28–35	9,146	8,405	9,008	5,069	5,892	6,163	3,011	4,046	4,411	1,395	2,823	3,119	525	1,807	1,989
43–50 years	1905–12	20–27	9,188	7,567	7,979	5,528	5,242	5,557	3,129	3,742	4,007	1,528	2,720	2,968	736	1,903	1,999
39–42 years	1913–16	16–19	7,450	6,387	6,700	4,980	4,643	4,990	2,800	3,490	3,711	1,602	2,604	2,854	809	1,926	2,090
35–38 years	1917–20	12–15	5,486	5,579	5,858	3,675	4,191	4,400	2,320	3,223	3,381	1,276	2,475	2,664	587	1,851	1,999
31–34 years	1921–24	8–11	4,290	4,332	4,415	3,007	3,457	3,546	1,963	2,790	2,885	1,123	2,195	2,299	490	1,619	1,728
29–30 years	1925–26	6–7	3,301	3,501	3,565	2,465	2,934	2,799	1,639	2,411	2,455	964	1,942	1,990	454	1,468	1,533
27–28 years	1927–28	4–5	2,463	3,005	3,021	1,908	2,504	2,521	1,319	2,103	2,128	765	1,702	1,751	306	1,257	1,310
26 years	1929	3	2,034	2,518	2,504	1,585	2,140	2,134	1,045	1,871	1,878	570	1,523	1,546	228	1,119	1,169
25 years	1930	2	1,930	2,167	2,155	1,465	1,946	1,941	1,069	1,662	1,658	585	1,325	1,324	234	937	927
24 years	1931	1	1,766	2,039	2,014	1,348	1,742	1,725	921	1,394	1,381	470	1,024	1,008	188	539	515
23 years	1932	0	1,689	1,910	1,826	1,240	1,335	1,243	814	766	716	406	383	358	163	153	143
								1934 Income (in Dollars)									
69 years and over	Prior to 1889	46+	†	7,367	7,570	‡	5,155	5,513	2,500	3,292	3,700	‡	1,861	2,225	†	1,050	1,229
61–68 years	1889–96	38–45	†	8,460	9,372	‡	5,700	6,264	2,200	3,793	4,280	‡	2,294	2,625	†	1,105	1,160
53–60 years	1897–1904	30–37	7,848	7,951	8,548	4,147	5,443	5,841	2,523	3,745	4,095	1,305	2,520	2,751	631	1,558	1,711
45–52 years	1905–12	22–29	9,171	7,230	7,665	5,426	4,980	5,271	3,040	3,524	3,788	1,579	2,526	2,688	921	1,826	1,893
41–44 years	1913–16	18–21	7,293	6,221	6,542	4,576	4,518	4,863	2,892	3,319	3,540	1,667	2,471	2,655	1,042	1,829	1,966
37–40 years	1917–20	14–17	5,560	5,393	5,656	3,667	4,058	4,278	2,414	3,101	3,271	1,514	2,379	2,525	848	1,839	1,960
33–36 years	1921–24	10–13	4,101	4,323	4,405	3,055	3,387	3,499	1,902	2,676	2,801	1,276	2,113	2,219	694	1,625	1,752
31–32 years	1925–26	8–9	3,560	3,554	3,601	2,468	2,892	2,949	1,700	2,380	2,442	1,123	1,929	2,002	526	1,513	1,581
29–30 years	1927–28	6–7	2,658	3,066	3,120	2,028	2,507	2,533	1,439	2,106	2,141	1,015	1,745	1,806	500	1,298	1,362
28 years	1929	5	2,209	2,635	2,658	1,764	2,209	2,227	1,296	1,929	1,946	934	1,593	1,621	431	1,244	1,266
27 years	1930	4	2,149	2,370	2,371	1,621	2,044	2,044	1,224	1,789	1,797	889	1,431	1,443	408	1,083	1,093
26 years	1931	3	2,028	2,155	2,146	1,536	1,900	1,895	1,171	1,578	1,571	835	1,265	1,261	352	954	949
25 years	1932	2	1,793	2,002	1,999	1,442	1,701	1,693	1,113	1,396	1,392	815	1,107	1,104	336	837	835
24 years	1933	1	1,664	1,911	1,895	1,325	1,562	1,551	991	1,272	1,265	606	960	954	242	526	520
23 years	1934	0	1,388	1,391	1,311	1,093	976	939	744	642	617	372	321	309	149	128	123

* That is, includes all graduates and all "other" engineers. † Between 50 and 100 engineers reported. ‡ Between 10 and 50 engineers reported.

American Engineering Council

The Washington Embassy for Engineers, the National Representative of a Large Number of National, State, and Local Engineering Societies Located in 40 States

Federal Public Works Situation

In addressing Congress on the state of the Union, at the opening of the Third Session of the Seventy-Fifth Congress, President Roosevelt staunchly defended the Administration's system for the relief of the unemployed and indicated that he would not favor substituting a dole for work relief payments. In that message, the President asked for the help of capital and labor with a nation-wide effort to restore economic balance and provide employment for a majority of the people. Since that time a number of conferences have been held with representatives of business, big and little; and except for an additional emergency appropriation to the Works Progress Administration, the Administration insists it is giving private capital and private enterprise an opportunity to meet the situation.

Spending is being reduced by all of the "emergency agencies" except the Works Progress Administration, and loans are being withheld until there is definite assurance that private capital has refused to finance sound enterprise. This is said to be particularly true in the several divisions of the Reconstruction Finance Corporation.

The results of public and private cooperation are encouraging, but reports from all sources indicate that sustained unemployment may exert so much pressure upon Congress that large appropriations may be made during the closing days of this session for emergency relief purposes.

Members of Congress, who are opposed to the dole, are beginning to ask what classes of "work relief" should be specified if the government is called upon to undertake another emergency spending program. Administrative executives who are in line to handle such programs are reviewing their experiences in an effort to be better prepared than heretofore to approve only those projects which are most worth while. All parties agree that the government should undertake to provide employment only on that type of public works which are most likely to continue to be of public service through the years in which the people themselves are expected to pay for such permanent improvements with taxes.

Several of those who are studying this difficult problem are inclined to favor preparations for satisfying public works deficiencies as much as possible with those classes of labor which may become available. That raises the questions: "What and where are the public works deficiencies?" "How can we avoid local political pressure and encourage projects designed to satisfy actual public works deficiencies?" Such questions seem to challenge engineers even more than other citizens to inventory public works deficiencies by political subdivisions and help prepare a program or a series of programs of public works which might be undertaken in periods of economic depression or other emergencies.

Obviously, such a survey of public works needs would be a large undertaking, even as a cooperative enterprise for the entire engineering profession, but it has all of the earmarks of a genuine opportunity for engineers in all parts of the country to make a major contribution towards the more effective use of public monies, especially in emergencies.

Council wishes its member societies to know that the staff is not only keeping in close touch with the situation in Washington, but is anxious to have their observations and opinions for staff and committee guidance.

Works Progress Administration Seeks Criticism of Its Activities

The American Engineering Council, the American Institute of Architects, American Municipal Association, American Public Welfare Association, American Society of Planning Officials, National Aeronautic Association, National Education Association (Department of Adult Education), National Recreation Association, U. S. Bureau of Public Roads, and U. S. Conference of Mayors have been requested to cooperate with the Works Progress Administration in the "United States Community Improvement Appraisal" being undertaken to determine the value to the public of thousands of projects executed under CWA, FERA, WPA, and other programs providing for the emergency relief of destitute citizens of the United States.

Cooperating organizations and agencies are asked to name a "National Appraisal Committee" of nine or more unbiased and well-known citizens to summarize, interpret, and make recommendations regarding the future use of several thousand community reports on "relief work" in 42 states. For various reasons Connecticut, Illinois, Missouri, Ohio, Vermont, and Wisconsin are not participating in this survey. State appraisal committees are reported to vary in composition but they are being sponsored by state planning boards, highway commissions, women's clubs, the League of Municipalities and other associations, governors, mayors, county judges, legion officials, labor representatives, architects, engineers, journalists, ministers, and other professional people. Each state has organized its own committee, but it is claimed that an honest effort has been made in all instances to create state committees who will insist that fair valuations be placed upon all projects handled by relief agencies.

Since many changes have been made in regional, state, county, and municipal relief organizations participating in CWA, FERA and WPA programs, it is argued that supporting facts regarding projects coming into this appraisal are likely to be fairly representative when they are compared by communities in all parts of the country. In any event, the Works Progress Administration is asking other agencies and the public to see if its work has been useful and permanent, or "boon-doggling" and "leaf-raking." They ask outsiders to judge whether relief workers have been employed to the best of their capabilities, or allowed to "lean on their shovels" and impose on the nation's generosity. WPA asks: "Has it been more constructive and more American to give work to the able-bodied and needy unemployed, in view of the added cost, than merely to provide them with food and shelter and let them wait in idleness for private jobs?"

No contest is involved in this appraisal or survey. Instructions to WPA employees preparing material for the reports provide for three divisions: municipal, county, and state. Each division is submitting its findings to the State Appraisal Committee. The State Appraisal Committee is to prepare a report appraising the types of projects and methods of operations from the twin standpoints of (a) effect on the unemployed and (b) effect on the communities as a whole. That report with copies of supporting reports from the state, the counties, and municipalities is to be forwarded to the Works Progress Administration in Washington by whom the entire compilation shall be made available to the National Appraisal Committee. The National Ap-

Forecast for April "Proceedings"

A Theory of Silt Transportation
by W. M. Griffith, Esq.
Presents a useful method for designing stable channel sections and for studying the effects of river control works on depths of flow.

De-oxygenation and Re-oxygenation
by Clarence J. Velz, Assoc. M. Am. Soc. C.E.
A technique for analysis pertaining to the design of projects to correct stream pollution.

Second Symposium on Power Cost
Six papers on the cost of energy generation by the following authors: H. K. Barrows, John C. Page, M. R. Scharff, W. F. Uhl, and E. B. Whitman, Members Am. Soc. C.E.; and C. F. Hirshfeld and R. M. Van Duzer, Jr.
Six papers on the economic aspects were published as the first symposium in December "Proceedings." A third symposium, on costs to the consumer, is planned for future publication.

Economics of Sewage Treatment
by George J. Schroepfer, Assoc. M. Am. Soc. C.E.
Concentrated, extensive, and valuable cost data, and a demonstration of their use in making economic comparisons.

praisal Committee is to prepare a nation-wide report outlining its opinion of (1) the relative worth-whileness of the programs to the city, county, state, or other political subdivision, in the light of both present and future needs, and (2) the relative worth-whileness of the programs to the needy unemployed people, who were given work by them. The national report is to be delivered to the national cooperating agencies, previously referred to, with the suggestion that it be made available for public use.

Council has responded to this request with a number of suggestions naming nationally known members of the engineering profession as eligibles for the National Appraisal Committee. The American Institute of Architects has seconded several nominations for membership on that committee from the American Engineering Council's recommendations. Thus the two organizations representing allied technical societies have united their efforts to provide the National Appraisal Committee with sound judgment and with that engineering knowledge and experience necessary for the intelligent appraisal of "work relief projects" involving construction and maintenance of public works in almost all of its ramifications. In the event that all engineer nominees or their alternates accept, there will be three engineers and three business executives on the committee. Member societies are urged to acquaint themselves with the Appraisal Committee in their own state and to advise the American Engineering Council of their opinion of value of the "appraisal" to engineering and in the public welfare.

Opinions of Member Societies Essential to Council's Effectiveness

Press services out of Washington have a weakness for exaggerating the national furor created by recurring tempests over pending legislation, administrative action, decisions of the judiciary, and hearings, investigations, etc. The news behind the news is, therefore, frequently more informative than spot news. Council can give its member societies more of the news behind the news, and more interpretation. Many of the forthcoming releases to be given in the A.E.C. Bulletin will be devoted to less "newsy" and more interpretative articles. They will have to do with current federal legislation, federal engineering and construction activities, engineer appointments to government positions, reviews and interpretations of federal government reports and releases, work being done by the American Engineering Council, work on which representatives of the American Engineering Council are cooperating with representatives of other organizations, announcements from member societies, etc.

The A.E.C. Bulletin is designed to provide member societies with intimate knowledge of public affairs and information regarding fields of activity not covered by other engineering organizations.

The opinion of member societies regarding the activities of the American Engineering Council, if expressed to the Assembly and Executive Committee through headquarters, will be summarized by the staff and, when officially approved, used to indicate the judgment or attitude of the organization of engineering organizations concerning matters of interest to the engineering profession and problems in the public welfare. Such expressions of considered engineering opinion from all affiliated bodies are solicited by Council's officers as a basis for the formulation of policies, and for staff guidance in expressing engineering attitude on major issues.

Washington, D.C.
March 14, 1938

Appointments of Society Representatives

William G. Atwood and Sir John Henry Butters, Members Am. Soc. C.E., were asked to represent the Society at the conference of the Australian Institution of Engineers, held in Sydney during the week commencing March 28th, in connection with the celebration of Australia's 150th anniversary.

William H. Chorlton, B. F. Hastings, and Samuel I. Sacks, Members Am. Soc. C.E., have been appointed Society delegates to the annual meeting of the American Academy of Political and Social Science, to be held at the Bellevue-Stratford Hotel in Philadelphia on April 1 and 2.

News of Local Sections

Scheduled Meetings

Buffalo Section—Luncheon meeting at the Buffalo Athletic Club on April 12, at 12:15 p.m.

Central Ohio Section—Luncheon meeting at the Chittenden Hotel on April 21, at 12 m.

Cleveland Section—Luncheon meeting at the Chamber of Commerce on April 5, at 12:15 p.m.

Colorado Section—Dinner meeting at the University Club, Denver, on April 11, at 6:30 p.m.

Los Angeles Section—Dinner meeting at the University Club, Los Angeles, on April 13, at 6:15 p.m.

Metropolitan Section—Meeting in the Engineering Societies Building, New York, on April 20, at 8 p.m.

Mid-South Section—Annual Meeting at the Marion Hotel, Little Rock, Ark., on April 29 and 30, 1938.

Nashville Section—Dinner meeting in Kissam Hall at Vanderbilt University on April 5, at 6:30 p.m.

North Carolina—Annual meeting at the Carolina Hotel, Pinehurst, on April 30, at 9:30 a.m.

Philadelphia Section—Dinner and meeting at the Engineers Club on April 20, at 6:00 p.m. (meeting 7:30 p.m.)

Pittsburgh Section—Joint meeting with Engineers Society of Western Pennsylvania at the William Penn Hotel on April 29, at 8:00 p.m.

Sacramento Section—Regular luncheon meetings at the Elks Club every Tuesday, at 12:10 p.m.

St. Louis Section—Luncheon meeting at the Mayfair Hotel on April 25, at 12:15 p.m.

San Diego Section—Regular meeting on April 28.

San Francisco Section—Dinner meeting at the Engineers Club on April 19, at 5:30 p.m.

Seattle Section—Dinner meeting at the Engineers Club on April 25, at 6:00 p.m.

Spokane Section—Luncheon meeting at the Crescent Tea Room on April 8, at 12 m.

Tacoma Section—Regular meeting on April 11.

Tennessee Valley Section—Dinner meeting of the Knoxville Sub-Section at the University of Tennessee Cafeteria on April 7, at 6:15 p.m.

Texas Section—Spring meeting of the Texas Section at the Texas State Hotel, Houston, on April 29 and 30; luncheon meeting of the Dallas Branch at the Dallas Athletic Club on April 4, at 12:15 p.m.; luncheon meeting of the Fort Worth Branch at the Blackstone Hotel on April 9, at 12 m.

Virginia Section—Joint meeting with Engineers Club of Hampton Roads and state sections of Founder Societies at Norfolk, Va., on April 29 and 30.

Recent Activities

Buffalo Section

On February 14 the Buffalo Section sponsored the third annual engineers' dinner, which attracted an attendance of 207. Brief remarks of greeting were made by Mayor Thomas L. Holling, while Carey H. Brown, superintendent of engineering for the Eastman Kodak Company, asked the cooperation of the members in assisting the Rochester Section to act as host to the Fall Meeting of the Society. The guest of honor and speaker, Maj.-Gen. Smedley D. Butler, was then introduced. General Butler spoke of his engineering experiences and discussed the international situation.

Central Illinois Section

An illustrated lecture by Langdon Pearse provided an interesting evening for the 24 members and guests present at a dinner meeting of the Central Illinois Section, which was held in Springfield on January 21. Mr. Pearse, who is sanitary engineer for the Sanitary District of Chicago, gave a résumé of the development of the District and described its present activities. On February 18 the Section entertained the ladies with a dinner meeting at the Inman Hotel in Champaign. Following dinner Rexford Newcomb, dean of the College of Fine and Applied Arts of the University of Illinois,

gave an interesting non-technical talk on the missions of the Southwest, touching particularly on their architecture. There were 35 present.

CENTRAL OHIO SECTION

A luncheon meeting of the Central Ohio Section took place at the Chittenden Hotel in Columbus on February 17, with 37 present. On this occasion the Section was addressed by L. G. Finlay, of the New York City office of the Raymond Concrete Pile Company. Mr. Finlay's topic was foundations, and he illustrated his talk with lantern slides depicting typical installations in different parts of the world.

CLEVELAND SECTION

The February meeting of the Cleveland Section took place on the 15th. After a brief report of the Annual Meeting of the Society, given by Arthur F. Blaser, the speaker of the occasion was introduced. This was Kirk C. Schaible, commanding officer, 408th Quartermaster Regiment, who gave a talk on "The Quartermaster Corps of the Army and its Relation to National Defense." There were 160 present at the March meeting of the Section, which was held on the 8th. The topic under discussion at this session was the Main Avenue bridge, on which construction will soon start. The speakers on the subject were W. E. Blaser and F. L. Plummer, respectively bridge engineer and chief designing engineer of the Cuyahoga County Engineer's office; J. F. Gorman and J. F. Curry, county commissioners; J. O. McWilliams, county engineer; and Wilbur J. Watson, consulting engineer.

DAYTON SECTION

There were 27 present at the February meeting of the Dayton Section. After a brief business discussion those present had an opportunity to hear Charlton D. Putnam, former chief engineer of the Greendale Housing Project in Milwaukee, Wis., speak on the subject, "Planning and Building a Greenbelt Town." An enthusiastic question-and-answer period followed the address.

DISTRICT OF COLUMBIA SECTION

On February 9 the District of Columbia Section of the Society participated in a joint meeting, sponsored by the Washington Society of Engineers and attended by local branches of the other Founder Societies and by the Society of American Military Engineers. Following a dinner at the Press Club, about 500 engineers heard Guy Atkinson, president of the Interior Construction Company, contractors for Grand Coulee Dam, relate the story of carrying out the first contract for the lower section of the dam. Another meeting of the District of Columbia Section and the Washington Society of Engineers took place on February 16, with 254 present. On this occasion the program centered around the showing of sound motion pictures of the construction of the Golden Gate Bridge. Charles M. Jones, assistant chief engineer of the John Roebling's Sons Company, came from Trenton, N.J., to give details of the work and to answer questions. After the meeting refreshments were served.

HAWAII SECTION

The Hawaii Section held a dinner meeting at the Oahu Country Club in Honolulu on February 16. This gathering took the form of a reception for visiting Society officers—President Riggs and Ralph R. Rumery, assistant treasurer. The ladies of the Section had been invited to meet Mrs. Riggs and Mrs. Rumery, and in all there were 52 present. A short message of greeting was given by Mr. Rumery, while Dr. Riggs presented the address of the evening. In his talk Dr. Riggs outlined the history and growth of the Society, discussed its relationship to other engineering societies, and spoke of its aims and activities.

INDIANA SECTION

Following its annual custom, the Indiana Section of the Society joined the Indiana Engineering Council, local groups of the other Founder Societies, the Indiana Society of Professional Engineers, and the Fort Wayne Engineers Club in holding an all-day meeting in Indianapolis on February 25. During its business session the Section elected the following officers for the coming year: Charles A. Ellis, president; Fred Kellam, vice-president; Denzil Doggett, secretary-treasurer; and K. B. Wolfskill, assistant secretary. The afternoon technical session consisted of the showing of a motion picture of the construction of the Golden Gate Bridge, a discussion of the Engineers Registration Law in Indiana, and a talk on and demonstration of electronic devices. The bridge picture was discussed by Professor Ellis, who was responsible for the tower and suspension span design for the structure. The principal speaker at the dinner meeting was L. W. Wallace, director of research for the Crane Company, whose topic was "The Engineer and Civilization." D. M. Hanson, president of the Fort Wayne Engineers Club, also addressed the meeting, and M. R. Keefe, retiring president of the Indiana Engineering Council, presented his annual report.

ITHACA SECTION

There were 34 present at a dinner meeting of the Ithaca Section, which was held in Willard Straight Hall on the campus of Cornell University on January 26. The after-dinner speaker was C. S. Robinson, civil engineer of Ithaca, who gave an illustrated talk on modern methods and equipment for aerial surveys. The February meeting took place on the 24th, with 37 in attendance. Following dinner the Section met with the Cornell University Student Chapter and heard H. C. Tammen, consulting engineer of New York City, give an illustrated lecture on the design and construction of the Neches Bridge.

KANSAS STATE SECTION

The Kansas State Section held its annual meeting in Lawrence, Kans., on February 18. The list of 46 present included members of the University of Kansas Student Chapter. During the business session the following officers for 1938 were elected: W. E. Baldry, president; M. W. Furr, vice-president; and F. W. Epps, secretary-treasurer. The speaker was R. C. Gowdy, Vice-President of the Society and chief engineer of the Colorado and Southern Railroad, who discussed Society affairs.

LOS ANGELES SECTION

On February 9 the Los Angeles Section held a meeting at the University Club, which was attended by 198. The technical program on this occasion consisted of talks by Julian Hinds, chief engineer of the Metropolitan Water District of Southern California, who discussed the design and construction of large steel and precast concrete pipes on the distribution system of the Colorado River Aqueduct; and Walker R. Young, construction engineer for the U. S. Bureau of Reclamation, who read a paper on the Central Valley Project. Both talks were illustrated with lantern slides.

The Junior Forum of the Los Angeles Section met at the University Club on the same day. Two students from the University of Southern California—John Duthie and Thomas Guardia—were the speakers on this occasion.

MID-MISSOURI SECTION

A luncheon and technical meeting of the Mid-Missouri Section of the Society was held at the Missouri Hotel in Jefferson City on March 1, with R. C. Gowdy, Vice-President of the Society, as guest of honor. Various matters of interest to the Section were discussed at this session, and Mr. Gowdy gave an informal talk, devoting some time to explaining Society finances and the budget for the current year.

NEW MEXICO SECTION

The January meeting of the New Mexico Section took place in Santa Fe on January 28, with 26 present. Numerous matters of interest to the Section were discussed during the business session, and the technical program consisted of a talk by Thomas M. McClure, state engineer, who discussed the Roswell artesian basin. On February 11 the Section sponsored the third all engineers' banquet, which was held in Albuquerque. Following an excellent buffet dinner, a program of entertainment and floor show were enjoyed. There were 185 present.

NORTHWESTERN SECTION

There were 33 members and guests present at a dinner meeting of the Northwestern Section, held at the University of Minnesota in Minneapolis on February 4. After a brief business session J. C. Stevens, consulting engineer of Portland, Ore., was introduced. Mr. Stevens, who is chairman of the Society's Hydraulic Research Committee, gave an interesting talk on the Colorado River.

PANAMA SECTION

A talk by Brig.-Gen. George B. Pillsbury was the feature of a meeting of the Panama Section, held in Panama City on January 31. General Pillsbury, who has been in the Corps of Engineers,

U. S. Army, for many years, spoke on the subject of "Federal Policy and Practice in Works of Flood Control," emphasizing particularly the flood-control works of the lower Mississippi River valley. He outlined the reasons why flood control is necessary and showed the development of flood-control works from individual and local efforts to the huge federal programs now in force. The attendance numbered 24.

Philadelphia Section

Members of the Philadelphia Section enjoyed their annual social gathering on February 19. The meeting, which this year celebrated the twenty-fifth anniversary of the founding of the Philadelphia Section, was opened by W. H. Chorlton, president of the Section, who made some remarks appropriate to the historical side of the occasion. Then Lyle L. Jenne, chairman and master of ceremonies, took charge of the entertainment program. There were tricks by a magician, a double ventriloquist act, and songs by Marie Zara, soprano of the Philadelphia Civic Opera Company. After the entertainment refreshments were served, and dancing was enjoyed until an early hour. There were 180 members and guests present.

Pittsburgh Section

During February the Pittsburgh Section of the Society held two joint meetings with the Engineers Society of Western Pennsylvania. On February 11, there were 84 members and guests present at a meeting held in the William Penn Hotel. On this occasion Albert J. Dawson, of the Dravo Corporation of Pittsburgh, presented a paper on the subject, "Pittsburgh River Facilities—Engineering Problems of Maintenance and Use." A general discussion followed. On the 25th a meeting was held in the Mellon Institute. The three speakers heard then were A. V. Karpov, designing engineer for the Aluminum Company of America; R. K. Bernhard, consulting engineer for the Baldwin Southwark Company; and E. C. Hartmann, research engineer for the Aluminum Company of America.

Portland (Ore.) Section

On March 4 the Portland (Ore.) Section participated with local groups of the other engineering societies in holding a dinner meeting, which was attended by 100. An interesting illustrated talk was given by Holland H. Houston, electrical engineer, whose topic was "Economic Considerations Affecting the Development of Interconnected Power Systems." His talk was then discussed by C. I. Grimm, E. Pearson, and C. Carey.

Providence Section

Between 50 and 60 members and guests attended the February 9 meeting of the Providence Section. On this occasion the speaker was Louis W. Cappelli, Secretary of State, who discussed Rhode Island, pointing out its advantages for industry and recreation and showing how the engineering profession can aid in developing the state's natural resources. Mr. Cappelli also presented two films in color, which showed how other states have capitalized their assets.

Sacramento Section

For the past two months the Sacramento Section has continued its custom of holding weekly luncheon meetings. The list of speakers on these occasions has included Harold Doud, captain of the 30th Infantry, U. S. Army; Walter McGinty, who is in charge of engineering and construction at the Boeing School of Aeronautics, Oakland, Calif.; Eugene P. Burton, of the Aluminum Company of America; Thomas E. Stanton, Jr., Director of the Society; and Harry E. Tyler, dean of counseling and student personnel of Sacramento Junior College. The average attendance at these sessions was about 50. On January 13 members and guests enjoyed the annual dinner of the Section, which attracted an attendance of 151.

San Francisco Section

The San Francisco Section held its first regular meeting for 1938 on February 15. The audience, which numbered 148, heard a "progress report" on the Golden Gate International Exposition. The speakers appearing on this program were A. McCrystal, who discussed special events; J. J. Gould, whose topic was construction progress; and Frank Peterson, who took up the subject of finances. Several committee reports were also heard at this session. A special meeting of the Section, held in honor of President Riggs, took place on March 4. The list of 67 present at this gathering included T. E. Stanton, Jr., Director of the Society.

Spokane Section

An open discussion of the labor situation was the feature of the January meeting of the Spokane Section, held at the Crescent Tea Room on the 14th. The subjects of engineers' salaries and of the license law situation were also discussed briefly. There were 11 present. The meeting held on February 11 was devoted to a discussion of various business matters, including the new Local Section set-up.

Syracuse Section

There were 20 present at a meeting of the Syracuse Section, which took place on February 15. The business session included the reading of committee reports and a report by Francis McKeon on a conference with the head of the State Department of Public Works concerning the appointment of engineers on public committees and commissions. Then John A. Giles, city engineer of Binghamton, N.Y., gave an interesting illustrated talk on the flood-control work done by the city of Binghamton. He was assisted by S. P. Carman, designing engineer for the city of Binghamton.

Tacoma Section

Business discussion occupied part of the February meeting of the Tacoma Section, which attracted an attendance of 35 members and guests. This was followed by a report on the Annual Meeting of the Society, given by R. K. Tiffany, who outlined some of the problems faced by the Board. Then John Wilson, of the John A. Roebling's Sons Company, presented a film showing the construction of the Golden Gate Bridge.

Tennessee Valley Section

The Asheville Sub-Section of the Tennessee Valley Section met at the George Vanderbilt Hotel on January 24, with 27 in attendance. On this occasion there was an illustrated talk by C. E. Blee, construction engineer for the Tennessee Valley Authority, who described the Hiwassee Dam Project. Considerable discussion followed.

On January 6 the Knoxville Sub-Section held a meeting, at which color motion pictures of wild life in the Norris Dam area were shown by a staff member of the Tennessee Valley Authority. There were 128 present. At a meeting of this Sub-Section held on February 3, W. J. Pollock addressed the group on "Cost Engineering and Cost Accounting." The attendance numbered 35.

The Muscle Shoals Sub-Section met at Pickwick Dam on January 13, with 30 present. Mr. Pollock, who was also speaker on this occasion, discussed utility valuation. There were 12 present at a meeting of the Sub-Section, held at Pickwick Dam on February 10. The technical program consisted of a talk on the malaria-control program of the Tennessee Valley Authority, which was given by C. C. Kyker, sanitary engineer for the Authority.

Toledo Section

On February 26 members of the Toledo Section made an inspection trip through the plant of the Interlake Iron Corporation in Toledo. The trip, which lasted three hours, included a demonstration of the pouring of iron into "pigs," the method of the preheating of the furnace blast, and the manufacture of coke.

Virginia Section

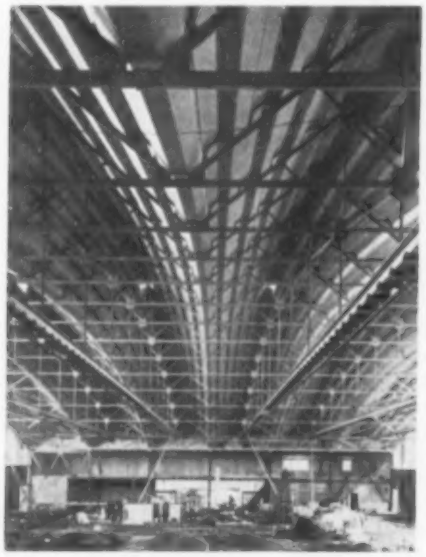
The annual meeting of the Virginia Section took place at the Jefferson Hotel in Richmond on February 23, the committee in charge of arrangements consisting of A. W. Harman, chairman, C. M. Andrews, and H. W. Church. During a business session in the morning the following officers for 1938 were elected: W. T. Howe, president; C. W. Johns, E. W. Saunders, and G. M. Bowers, vice-presidents; and P. A. Rice, secretary-treasurer. A talk on Society affairs was given at this session by George T. Seabury, Secretary of the Society. In the afternoon there was a technical session, at which three students—W. H. Carper, John Ward, and P. W. Gwaltney—presented interesting papers. Then John R. Dawson, assistant structural engineer for the National Advisory Committee for Aeronautics, described the construction of a model tank at Langley Field. He was followed by Marsden C. Smith, who discussed the Richmond filtration plant. The speaker at the evening session was E. A. Kincaid, professor of finance at the University of Virginia.

ITEMS OF INTEREST

Engineering Events in Brief

Civil Engineering for May

Definitely scheduled for May is an article by H. Orbanowski, Jun. Am. Soc. C.E., describing the unique all-steel exhibition hall built by the Stahlwerks-Verband for last year's exposition at Düsseldorf, Germany. The main supporting roof structure of the building, as shown in the accompanying illustration, consists



The All-Steel Exhibition Building at Düsseldorf, Germany

of six adjacent, hollow, two-hinged arches of triangular cross-section. The corrugated plates perform the dual function of roofing and load-transferring elements.

From Oregon, R. H. Baldock, State Highway Engineer, contributes a paper describing the methods used in his state for building bituminous macadam highways. This type of road, he reports, has been built for as little as $10,000 per mile (exclusive of grading), though under unfavorable conditions the first cost may be twice that amount.

An interesting program of bridge-strengthening on the Atlantic Coast Line Railroad is reported by George G. Thomas, M. Am. Soc. C.E. Some forty old steel spans, originally designed for Cooper's E-40 loading, have been reinforced to meet the requirements of the E-60 loading, and the work has been done without interruption to traffic.

Municipal engineers will be attracted to the argument of Alfred Brahdy, M. Am. Soc. C.E., in favor of subways as an alternative to street-widening projects. He suggests that a subway may properly be financed partly as a railway and partly as a street improvement, with abutting and surrounding property contributing a part of the cost.

It is hoped that a number of papers scheduled for presentation at the Spring Meeting of the Society can also be included in the May issue of Civil Engineering. If so, they will be selected from the fields of surveying, highway engineering, sanitary engineering, and erosion control.

Wise and Otherwise

Last month Professor Abercrombie posed two puzzlers, the first having to do with the shape of a metal plug that could be used for holes of three different shapes—circles, 1 in. in diameter; squares, 1 in. on each side; and isosceles triangles, having 1-in. base and 1-in. altitude. William Trillow, who suggested the problem, gives the answer shown in Fig. 1. The plug is described as "a right conoid with circular base of 1-in. diameter whose generating element terminates in the perimeter of the base at one extremity and in an orthogonally projected diameter of the base removed 1 in. from the base at the other extremity, the direction of the element remaining perpendicular to the projected diameter as it generates the conoid."

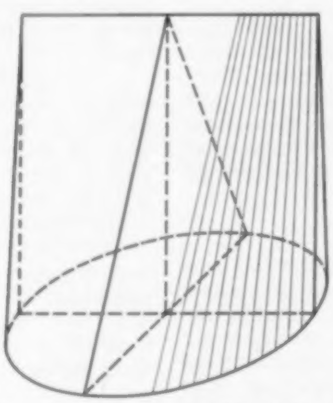


Fig. 1. The "Three-Way" Plug

A simpler answer, apparently equally satisfactory, is submitted by F. T. Llewellyn, M. Am. Soc. C.E. Mr. Llewellyn suggests starting with a cylinder 1 in. in diameter and 1 in. high, and trimming it in two sloping planes that pass through a diameter at the top and are tangent to the circumference at the bottom.

The second problem involved the Professor's fee for his services, which were $3.75 less than the foundryman's charges for manufacturing the plugs. The purchaser, wishing to pay both the Professor and the foundryman in cash, stopped at the bank to cash a check he had just received. In cashing this check, the teller made the mistake of paying out a number of dollars equal to the number of cents called for and a number of cents equal to the number of dollars called for. The purchaser now found that by supplementing the proceeds of the check with 64 cents he could just meet the combined charges of the foundryman and of Professor Abercrombie (whose fee amounted to $1.72 less than the face value of the check).

Let x represent the number of dollars and y the number of cents in the face value of the check. Then, expressed in cents, $100x+y$ is the face value and $x+100y$ is the amount paid by the teller. The Professor's fee is $100x+y-172$, and the foundryman's charge is 375 cents greater, or $100x+y+203$. The sum of the fee and the charge, $200x+2y+31$, is equal to $x+100y+64$ by the terms of the problem. Therefore, $98y=199x-33$.

But y cannot exceed 100, and both x and y are positive integers. Writing the equation in the form

$$y = 2x + \frac{3x-33}{98},$$

it is obvious that if $x=11$, $y=22$; and that all other corresponding integral values of x and y will occur only when x and y take on corresponding increments of ± 98 and ± 199, respectively. Therefore, 11 and 22 are the values sought, since they are the only set in which y lies within the required limits.

Thus, the check was written for $11.22; the engineer's fee was $9.50; and the foundryman's charge was $13.25.

A Modern Fable, with Apologies to Æsop

To "point a moral and adorn a tale," Frank W. Herring, Assoc. M. Am. Soc. C.E., created the chief character in this fable, a city engineer with a wonderful memory. The fable, here abstracted, appeared originally in the February 1938 issue of the ***Public Works Engineers' News Letter***, published by the American Public Works Association.

"Once there was a city engineer who knew where everything was. He was able to remember that in Walnut Street there was a 12-in. sewer, of vitrified clay, on a 2 per cent grade, 6 ft south of the north curb line. He remembered its approximate flow-line elevations and other intimate details. He was a walking map of the city's underground pipes. His memory was his pride; it was also his protection. He knew where everything was; everyone had to find out from him. His services were invaluable to his community.

"But one day the poor, hard-working fellow died. The map that was in his head died with him, unfortunately. And tremendous was the grief of the men the city engineer left behind to carry on. 'Ask Jake, the sewer foreman, if he remembers where this line is; tell that plumber he will just have to dig around to find that wye.' There were emergencies, such as

water-pipe breaks, when details had to be known immediately to forestall severe damage. Costly explorations had to be made before even minor work could be done. The engineering staff began to go slowly mad.

"The situation became so bad something had to be done about it. The new city engineer decided that a complete map and system of location records were indispensable. At considerable expense all the underground structures of the city were surveyed, and the assembled information transferred to a map of the city drawn to a generous scale. The field notes were safeguarded against damage or loss. On all extensions or alterations to the system made thereafter, complete notes were taken and transferred immediately to the underground map. And after that the engineering staff recovered its sanity, builders and plumbers recovered their good humor, and the cost of doing work fell even below what it had been before the poor old city engineer died.

"Moral: Insurance won't cover mental maps."

This fable will appeal especially to those concerned with the repair of underground utilities. In their efforts to avoid a catastrophe of the sort here so graphically recorded, they may wish to consult the Society's recently published Manual on Underground Utilities, which gives much helpful information on how to map and record subsurface structures in cities and towns.

Artisans of Fort Marion

By F. Hilton Crowe

Local Supervisor, Federal Writers' Project, WPA, St. Augustine, Fla.

This account of the construction of the oldest fortification in the United States, at St. Augustine, Fla., is of especial interest in connection with the Spring Meeting of the Society in Jacksonville, April 20–23, 1938. Those attending the meeting will have an opportunity, on Wednesday afternoon, April 20, to see this old masonry structure at close hand.

Fort Marion (Castillo de San Marcos), the oldest fortification in the United States, is an imposing symbol of the once mighty empire of Spain. It is also a fitting memorial to the unknown engineers, obscure workmen, and lowly peons who devoted their lives to its construction.

Courtesy National Park Service

Turret and Battlements of Fort Marion, at St. Augustine, Fla.

Begun in 1671, this quadrangular, four-bastioned masonry structure was 85 years in building. The engineers were constantly hampered by lack of funds and skilled labor; disease and mutiny demoralized the workers; and the fear of attack by the English was ever present. On the other hand, such labor as there was was cheap and abundant, and raw materials were near at hand. St. Augustine was fortunate in being near vast deposits of coquina stone on Santa Anastasia Island, just across the Matanzas River. It was also favored by being the governmental post of the Spanish in Florida, so that the hordes of convicts of the Spanish Empire could be assigned to labor there. Another source of cheap labor was the outlying Indian provinces, heavily populated by natives semi-skilled in the trades.

Among the manuscripts of the National Park Service (which now administers the fort) is a very human document made and certified by Menendez Marques, *contador* (accountant), and Antonio de la Rocha, treasurer and *tenedor de bastimentos* (bookkeeper of provisions), which concerns a statement of expenditures on Castillo de San Marcos. It itemizes the expenses from August 1671, when the stone fortress was begun, to May 1675. During this period the expenditure was 34,298 pesos, 6 reals, and 1 cuartillo—or roughly $34,298.75.

The highest wage recorded is that of three pesos a day to Ignacio Daza, chief engineer. Next in wages came the construction overseer and two master stone-workers, at 20 reals a day. As the real was worth about $12^1/_2$ cents, this was no princely sum. Ordinary stone-workers were paid 12 reals a day, while stone-cutters received only 8. The quarry overseer and the construction overseer or "pusher" rated only 6 reals.

Although most of the quarrying was done by convicts and captives, some free Indian and Spanish laborers were employed. These Spanish peons were paid 4 reals a day to the Indians' single real! This caused some dissatisfaction among the Indians, who resented such discrimination. The Indians, however, were given an allowance of corn in addition to their wages. The Spanish convicts were given an additional 6 cents a day for meat. But the Indians had to choose between foraging for game and vegetarianism.

The faithful animals employed are also mentioned—18 oxen at 16 pesos each, "to haul stone from the wharf," and 2 mules at 45 pesos each "to cart the large stone for the construction." The Spanish grammatical construction here seems to indicate that the mules were used for putting the stones into position on the building itself. They probably furnished the motive power of the windlass that dragged the coquina blocks up an inclined plane to the ramparts.

In April 1675 the construction of the fort received a check when a ship bringing supplies of food for the workers was wrecked on the Florida coast. This made it necessary to dismiss the peons, and retain only the overseers and stone-workers. Corn from the province of Timucua staved off famine until food arrived from New Spain.

Year after year the work on Castillo de San Marcos proceeded in a desultory fashion owing to lack of funds, lack of official interest, and recurring sieges of smallpox that decimated the workers. But soon the rising tide of English conquest struck fear to the hearts of the Spanish, and Don Antonio de Arredondo, royal engineer, was dispatched to St. Augustine in 1736 to repair and complete the fort, and to construct additional palisades and redoubts around the town. While here he constructed the beautifully arched casemates that made them bomb-proof in his day. The general excellence of the work on the fort was proved by the failure of the English General Oglethorpe in 1740 to destroy it by prolonged bombardment.

Centenary of Liége School of Mines Celebrated

ON NOVEMBER 26-27, 1937, appropriate ceremonies were held at Liége, Belgium, to commemorate the founding 100 years ago of the Liége School of Mines, now the Faculty of Engineering, University of Liége. The Society was represented by Léon Rucquoi, M. Am. Soc. C.E., whose report reads in part as follows:

"Owing to its location in the center of a very active coal-mining and industrial district, the School of Mines has played an important part in the development of this region and of the country at large. Geology and metallurgy have always been the two chief topics in which the School of Liége has had a leading competence. The development in the last 50 years of the important mining districts of the Belgian Congo, especially of the rich copper mines of the Katanga, has placed the names of many Liége men in the role of honor of the engineering profession."

NEW CIVIL ENGINEERING BUILDING AT THE UNIVERSITY OF LIÉGE, BELGIUM
In the Right Foreground Is the Mechanical Engineering Building, Still Under Construction. The Meuse River and the Industrial District Appear in the Background

Brief Notes from Here and There

SOME of those attending the Spring Meeting of the Society in Jacksonville, Fla., April 20-23, 1938, may wish to combine this trip with attendance at the convention of the American Water Works Association in New Orleans, April 25-29. Of especial interest is the day of inspection trips in Birmingham, Ala., planned for delegates on their way to New Orleans. Arrangements have been made to inspect several of Birmingham's large pipe factories and its unique industrial water supply system on Saturday, April 23. Further information may be secured from Harry E. Jordan, secretary of the American Water Works Association, 22 East 40th Street, New York, N.Y.

* * * *

THE Midwest Power Conference will be held in Chicago, Ill., on April 13-15, 1938, under the auspices of the Armour Institute of Technology and with the cooperation of six other colleges and universities of the Middle West. The program includes several subjects of interest to civil engineers, and a number of members of the Society are scheduled to present papers. Full details can be secured from Stanton E. Winston, conference secretary, Armour Institute of Technology, 3300 Federal Street, Chicago, Ill.

* * * *

THE Twentieth Annual Convention of the National Lime Association and the lime industry of the United States will be held at the Netherland Plaza Hotel in Cincinnati, Ohio, on May 9, 10, and 11, 1938.

* * * *

ENGINEERS in management will find food for thought in the simply-worded, illustrated financial "report to jobholders" for 1937 just issued by the Johns-Manville organization to give its employees—from department managers to laborers—an insight into "where the money comes from and where it goes." By means of "pie diagrams," cartoons, and short sentences of text, a complicated financial set-up is reduced to its simplest terms. (Somewhat similar pamphlets have previously been issued by such organizations as International Harvester and Caterpillar Tractor.) A report of this type, one would think, might be used to advantage by an electric utility for distribution to its customers.

NEWS OF ENGINEERS

Personal Items About Society Members

CHARLES M. NOBLE, assistant engineer for the Port of New York Authority, has been awarded the Clemens Herschel Prize of the Boston Society of Civil Engineers for his paper entitled "The Factor of Safety in Highway Design," presented at the January 1937 meeting of the Boston Society of Civil Engineers and published in the April 1937 Journal of this organization. The prize was made available through a gift from the late Clemens Herschel, Past-President and Honorary Member of the Society.

E. H. SCHNEIDER, formerly designing engineer on the Moffat Tunnel water projects for the Board of Water Commissioners of Denver, Colo., has opened an office as consulting engineer at 629 Denham Building, Denver, Colo.

R. R. LITEHISER, for a number of years chief engineer of tests for the Ohio State Department of Highways, has accepted the position of director of engineering for the New York Crushed Stone Association, with headquarters in Albany, N.Y.

R. B. JENNINGS recently resigned as chief designing engineer of the division of sewerage relief of the Columbus (Ohio) city engineer's office to become manager of the Columbus office of the Trane Company, whose main office is in LaCrosse, Wis.

CHARLES H. NICHOLS, consulting civil engineer of New York City, has been appointed executive and technical director of the Municipal Housing Authority for the city of Yonkers, N.Y.

GEORGE M. TAPLEY has been transferred from the U. S. Engineer Office at Conchas Dam, N.Mex., where he was in charge of the design of Conchas Dam, to the office of the Chief of Engineers, U. S. Army, Washington, D.C.

LEONARD C. HOLLISTER, formerly assistant designing engineer for the bridge department of the California State Division of Highways, has been promoted to the position of designing engineer.

V. V. MALCOM has assumed his new duties as manager of the Elastite Expansion Joint Department, specialty products division of the Philip Carey Company, Cincinnati, Ohio.

W. W. CALDWELL has resigned from the J. G. White Engineering Corporation to become vice-president and general manager of the building construction firm of Iglehart, Caldwell and Scott, Inc., 80 Broad Street, New York City.

EDWARD C. SEIBERT, commander, C.E.C., U. S. Navy, has been detached from his duties at the Bureau of Yards and Docks in Washington, D.C., and named officer in charge of construction for the Naval Air Station at Alameda, Calif.

A. Elliott Kimberly has resigned as chief engineer on sanitary projects for the PWA in Ohio to establish a consulting sanitary engineering practice, with offices in Columbus, Ohio.

Harry H. Hendon, who for the past two years has been serving as sanitary engineer of Jefferson County, Alabama, while on leave of absence from the Birmingham Industrial Water Supply Commission, has been named head of the recently enlarged county engineering department.

Harvey D. Stover is now project engineer for the bridge department of the California State Division of Highways. He was formerly designing engineer.

W. T. Ivey, formerly general superintendent of the Mississippi Division of the Peoples Water and Gas Company, has been elected a vice-president of that organization and will act as general manager of the natural gas-distribution systems of the company in Mississippi. His headquarters will be in Meridian, Miss.

G. A. Sedgwick, until recently assistant bridge designing engineer for the California State Division of Highways, has been made structural engineering associate for the California State Division of Architecture.

A. B. Jones, major, Corps of Engineers, U. S. Army, has been transferred from Duluth, where he was district engineer, to the office of the chief engineer in Washington, D.C.

George N. Schoonmaker, formerly director of public service in Toledo, Ohio, has been appointed to the newly created post of chief engineer of the Toledo Water Department.

Carl A. Trexel, commander, C.E.C., U. S. Navy, who has been serving as project manager of the Marine Corps Facilities Section of the Bureau of Yards and Docks, has been assigned to duty as design manager of the Bureau in Washington, D.C.

Frederick K. Wing has been appointed city engineer of Buffalo, N.Y. Mr. Wing has been chief engineer of the Niagara Frontier Planning Board since 1935.

Claude P. Owens and W. H. Root, respectively division engineer for the Missouri State Highway Department and maintenance engineer for the Iowa State Highway Department, have been granted a leave of absence to assist in the organization of the maintenance division of the Texas State Highway Department.

Carl A. Carlson, captain, C.E.C., U. S. Navy, is now general inspector and procurement officer for public works in the San Diego, Mare Island, and Puget Sound naval districts, with headquarters in San Francisco, Calif. He was formerly public works officer for the Mare Island Navy Yard.

Bernard L. Crozier, chief engineer of the Maryland Department of Public Works, has been elected president of the Maryland Association of Engineers.

A. H. Castelazo, previously junior bridge designing engineer for the California State Division of Highways, is now assistant structural engineering draftsman for the California State Division of Architecture.

Charles P. Williams has resigned as consulting engineer for the National Irrigation Commission of Mexico to become project engineer for the Ambursen Engineering Corporation of New York City. Mr. Williams will have entire charge of the field work on the Possum Kingdom Dam and powerhouse on the Brazos River near Mineral Wells, Tex.

Walter A. Doane, who ranks among the half-dozen or so oldest members of the Society, is still in active engineering work. Like his father before him, he was at one time city engineer of Meadville, Pa. His son, also an engineer, makes at least the third generation of engineers in that one community.

Eric Fleming, until recently engineer and architect for the Ambursen Dam Company, Inc., of New York City, is now structural engineer for Voorhees, Gmelin, and Walker, architects of the same city.

Lee H. Huntley recently resigned from the electrical division of the PWA to become construction engineer for the Ambursen Engineering Corporation of New York City on the Possum Kingdom Dam and powerhouse.

Ralph H. Chambers has established a consulting practice at 12 East 41st Street, New York City. He was formerly vice-president of the Foundation Company.

L. L. Huttleston has been appointed executive secretary of the Central New York State Parks Commission, with headquarters in Binghamton, N.Y.

DECEASED

James Anderson (M. '29) civil engineer of Lake Forest, Ill., died on February 6, 1938, at the age of 68. He was president of the James Anderson Company, which he founded in 1891, and trustee of the North Shore Sanitary District. Mr. Anderson had also served as engineer for many towns in the North Shore area, and was county surveyor of Lake County from 1896 to 1912.

Charles Walter Becker (Assoc. M. '20) of Amsterdam, N.Y., died on January 17, 1938, at the age of 46. For over twenty years Mr. Becker was in charge of the design of large construction projects and the supervision of heating, plumbing, and electric contracts. For several years he served as senior building construction engineer for the New York State Department of Public Works, and at various times he maintained a private engineering practice in Amsterdam.

The Society welcomes additional biographical material to supplement these brief notes and to be available for use in the official memoirs for "Transactions."

Charles Young Dixon (M. '03) engineer, U. S. Engineer Corps, River and Harbor Improvements, Detroit, Mich., died recently at the age of 74. In 1892 Mr. Dixon became connected with the Detroit office of the U. S. Engineer Department, where he remained for the rest of his life—as instrumentman, assistant engineer, and engineer, successively. His work there included the supervision of all channel improvements in the Detroit River.

Emmett Clarke Dunn (Assoc. M. '91) city manager of Alexandria, Va., died suddenly on February 13, 1938, at the age of 76. Mr. Dunn held the position of city engineer of Alexandria for almost thirty years prior to his appointment as city manager in 1934. He directed all public improvements made in Alexandria in the past forty years, during a period when the population of the city was tripled.

Alfredo Carlo Janni (M. '13) consulting engineer of New York City, died there on February 26, 1938, at the age of 68. A native of Italy, Mr. Janni came to this country as a young man and, for a number of years, was engaged in bridge engineering work for the Southern Railway and for the city of St. Louis. In 1918 the U. S. Shipping Board accepted his plan for concrete ships. Mr. Janni was credited with having introduced into American engineering literature the subject of bridges with elastic piers. He was a frequent contributor to engineering periodicals.

John Young Jewett (Assoc. M. '10) died at his home in Paso Robles, Calif., on February 1, 1938, at the age of 68. From 1904 to 1917 Mr. Jewett was a cement expert for the U. S. Bureau of Reclamation, and later held a similar position with the U. S. Bureau of Standards. From 1920 until shortly before his

death he was testing engineer for the City of San Diego, Calif., operating the testing laboratory and conducting tests and investigations for the city.

ARTHUR ROSS KENNEDY (Assoc. M. '27) was killed in an explosion on August 26, 1937, while in charge of dam construction for the Colombian Petroleum Company on the Barco Concession. Mr. Kennedy, who was 50, spent a number of years in Central and South America in the employ of the United Fruit Company. His work during these years included the development of the Guymos District, Honduras; the location of the Atlantic-to-Pacific railroad in Honduras; and port development in Guatemala.

WILLIAM ALFRED LAMB (M. '20) district engineer for the U. S. Geological Survey at Helena, Mont., died on February 10, 1938. Mr. Lamb, who was 56, had been with the U. S. Geological Survey for almost thirty-five years—from 1904 to 1910 on water-supply investigations, and from 1910 until his death as district engineer at Helena, where he was in charge of the Upper Missouri District.

ATTILIO FELIX LIPARI (M. '30) principal assistant to F. R. Harris, Inc., of New York City, died in that city on February 13, 1938, at the age of 48. Born in Sicily, Mr. Lipari had lived in this country since boyhood. During his connection with F. R. Harris, Inc., which began in 1926, he had charge of the design of numerous industrial and harbor projects in the United States, Russia, and Peru. During the war he was attached to the Italian Mission as liaison officer, with the rank of lieutenant.

MAURICE ALVIN LONG (M. '09) president of the M. A. Long Company, of Baltimore, Md., died at his home in that city on February 27, 1938. He was 62. For more than twenty years Mr. Long was architect and assistant chief engineer for the Baltimore and Ohio Railroad Company in charge of the design and construction of all building work for the system. In 1919 he resigned this post to establish the M. A. Long Company, which has erected many notable structures. At the time of his death Mr. Long was chairman of the Board of Directors of the Western Maryland Railway Company.

JOHN WILLIAM MARKS (M. '28) track supervisor for the Southern Railway Company at Chattanooga, Tenn., died on February 20, 1938, at the age of 48. For a number of years Mr. Marks was connected with the Southern Railway Company—from 1926 until 1935 as chief of party on location. He also was engineer and contractor on the construction of a railroad in Haiti for the Caribbean Construction Company. During the war he served as first lieutenant and, later, captain of Company "N," 22d Engineers, A.E.F.

FRANCIS CHARLES MCMATH (M. '24), who directed the construction of numerous railway bridges in the United States and Canada, died in Detroit, Mich., on February 13, 1938, at the age of 71. From 1900 until 1921 Mr. McMath was president of the Canadian Bridge Company, of Windsor, Ontario. During part of this period (1911 to 1919) he also served as consulting engineer for the St. Lawrence Bridge Company, Ltd., in connection with the cantilever bridge across the St. Lawrence River near Quebec. He retired several years ago.

GEORGE PUTNAM STOWITTS (M. '12) chief engineer of the inspection division of the PWA, Washington, D.C., died on March 5, 1938. He was 59. From 1900 to 1920 Mr. Stowitts was employed in varying capacities by the New York Central Railroad Company. Later he maintained a consulting practice in New York City, and from 1927 to 1933 he was engineer in charge of design and construction of a new railroad terminal for the Cincinnati Union Terminal Company.

JOHN ALEXANDER LOW WADDELL (M. '81; Hon. M. '37) consulting engineer of New York City, died there on March 3, 1938, at the age of 84. A detailed account of Dr. Waddell's career appears elsewhere in this issue.

Changes in Membership Grades

Additions, Transfers, Reinstatements, and Resignations

From February 10 to March 9, 1938, Inclusive

ADDITIONS TO MEMBERSHIP

ALBERTSON, JOHN GILBERT (Assoc. M. '38), With Thomas F. Bowe, 110 William St., New York, N.Y. (Res., 886 Midland Rd., Oradell, N.J.)

ANDERSON, EVERTT GORDON (Jun. '37), Officers, Club, Fort Logan, Colo.

BAKER, JAMES MONROE (Jun. '38), 2506 Jenny Lind St., McKeesport, Pa.

BARNEY, WILLIAM JOSHUA, JR. (Jun. '38), With W. J. Barney Corporation (Res., 103 East 75th St.), New York, N.Y.

BEARD, ABNER HAMILTON, JR. (Jun. '37), Asst. Public Health Engr., State Board of Health, Div. of Public Health Eng. and Sanitation, Osceola, Mo.

BOWEN, JOHN EDMUND (Assoc. M. '38), Chf. Engr., Great Lakes Steel Corporation, Stran-Steel Div., 607 Shelby St., Detroit, Mich.

BRODERICK, JOHN HEHRY (Affiliate, '38), Pres. and Treas., J. H. Broderick Co., Inc. (Res., 367 Walnut Ave.), Boston, Mass.

BURKE, HARRIS HUXLEY (Jun. '37), Care, U. S. Bureau of Public Roads, Reserve, N.Mex.

BUTLER, VADEN REYNOLDS (Jun. '38), R.F.D. 4, Scotia, N.Y.

CAWNISTRA, STEPHEN ANTHONY (Jun. '38), With Blum, Weldin & Co. (Res., 2711 Miles Ave.), Pittsburgh, (16) Pa.

CONVERSE, WILLARD BLAKE (Assoc. M. '38), Field Engr., Buffalo Sewer Authority (Res., 154 Sanders Rd.), Buffalo, N.Y.

COWGILL, JOSEPH MORELAND (Jun. '38), 4 Haviland St., Apartment 3, Boston, Mass.

CRON, FREDERICK WILLIAM (Assoc. M. '37), Asst. Engr., U. S. Bureau of Public Roads, 732 Quapaw Ave., Hot Springs, Ark.

CUNNINGHAM, MURRAY HUNT (Jun. '37), With Humble Oil & Refining Co., Anderson Hotel, Crowley, La.

DANA, FOREST CHARLES (M. '38), Prof., Gen. Eng., Iowa State Coll. (Res., 428 Lynn Ave.), Ames, Iowa.

DEGROVE, RUSSELL HENRY (Assoc. M. '38), Asst. Civ. Engr., Robert M. Angas, Box 358, Jacksonville, Fla.

DEWAN, THOMAS PAUL (Jun. '38), 402 East Chalmers, Champaign, Ill.

DEWEY, JOHN MARION (Jun. '37), Dist. San. Engr., Dist. Health Office, Salem, Mo.

TOTAL MEMBERSHIP AS OF MARCH 9, 1938

Members	5,647
Associate Members	6,162
Corporate Members	11,809
Honorary Members	24
Juniors	3,677
Affiliates	78
Fellows	1
Total	15,589

EDWARDS, MAXWELL CHARLES (Jun. '38), 608 East 4th St., Brooklyn, N.Y.

EVANS, JOHN CARLYLE (M. '38), Chf. Engr., The Port of New York Authority (Res., 38 East 37th St.), New York, N.Y.

FELLOURIS, JOHN HARRY (Jun. '37), 17 Holly St., New Bedford, Mass.

FINK, HOWARD LLEWELLYN (Jun. '37), Care, U. S. Bureau of Reclamation, Cavecreek, Ariz.

FORBES, ROBERT (Jun. '37), Junior Civ. Engr., TVA (Res., 110 Hill Top Lane), Norris, Tenn.

GILSON, W. IRVING (Assoc. M. '38), Brownsville, Tex.

GOFF, WAYNE LEROY (Assoc. M. '37), With U. S. Lighthouse Service, Box 136, Buffalo, N.Y.

GUSCIO, FRANCIS JOSEPH (Assoc. M. '38), Associate Engr., National Park Service (Res., 3128 Alvis Ave.), Richmond, Va.

HARTMAN, OTTO CHARLES (Assoc. M. '38), Engr., U. S. Engrs., 2819 South East Stevens St., Portland, Ore.

HASTINGS, GEORGE CORL (Jun. '38), 406 Naymut St., Menasha, Wis.

HEALD, HOWARD LEWIS (Jun. '37), Asst. Eng. Draftsman, Bureau of Indian Affairs, 616 West Coal Ave., Albuquerque, N.Mex.

JOBUSCH, FRED HENRY (Jun. '37), 1202 Churchman Ave., Indianapolis, Ind.

KAMMERER, RUDOLPH MITCHELL (Jun. '37), Westhampton Beach, N.Y.

KELLEY, COTT C. (M. '38), Chf. Field Engr. and Asst. Supt. of Constr., Tennessee Coal, Iron & R.R. Co. (Res., 530 Ridgeway Rd.), Fairfield, Ala.

KELSH, LAWRENCE JOHN (Jun. '37), 1366 State St., Salem, Ore.

Keppler, Louis Frank (Jun. '37), 152 West McMillan St., Cincinnati, Ohio.

Kiedaisch, W. Calvin (Assoc. M. '38), Res. Engr., Bridge Dept., State Div. of Highways, Box 6, Fortuna, Calif.

Kirkham, Rowland Edward (M. '38). Associate Prof., Civ. Eng., Oklahoma Agri. and Mech. Coll. (Res., 215 Melrose Drive), Stillwater, Okla.

Klunk, John Benedict (M. '38), Vice-Pres., The Continental Bitumen Co. (Res., 222 Dartmouth Drive), Toledo, Ohio.

Kraft, Elmer Alexander (Jun. '37), 6545 South Union Ave., Chicago, Ill.

Laird, Knight (Jun. '38), Care, Consolidated Gravel Co., Jonesboro, Ark.

Lantay, George Sylvester (Jun. '37), 499 West 133d St., New York, N.Y.

Leichtman, Adolph (Jun. '38), 1371 St. Marks Ave., Brooklyn, N.Y.

Leonard, Raymond Wesley (Jun. '38), Junior Engr., Water Resources Branch, U. S. Geological Survey, 220 Post Office Bldg., Asheville, N.C.

Lewis, Stanley Joseph (Jun. '37), Anderson Hotel, Crowley, La.

MacLean, Edward Archibald (M. '38), Rose Polytechnic Inst., Terre Haute, Ind.

McMahon, James Emmet (Assoc. M. '38), Care, State Bridge Dept., 806 California State Bldg., Los Angeles, Calif.

Maguire, George Campbell (M. '38), Engr., Coverdale & Colpitts, 120 Wall St., 23d Floor, New York, N.Y.

Maguire, Walter Joseph (Jun. '37), 2051 West Grand Boulevard, Detroit, Mich.

Maish, Frederic Fudge (Jun. '37), Apartment 27, Y.M.C.A., Anderson, Ind.

Mercado y de Aguilar, Francisco Vazquez del (M. '38), Executive Commr., Comisión Nacional de Irragación of Mexico, Campeche 262, Mexico, D.F., Mexico.

Morehead, Herbert Leslie, Jr. (Jun. '37), With Morehead-Frederickson Co., 217 Dows Bldg., Cedar Rapids, Iowa.

Myers, Edwin DeMond (Jun. '37), Box 134, Rockledge, Fla.

Ormsby, Orville Henry (Jun. '37), 578 Madison St., Gary, Ind.

Rait, Donald Myron (Jun. '37), Apprentice, Gen. Chemical Co. (Res., 17 Franklin Ave.), Claymont, Del.

Reeve, John Orson (Jun. '37), Junior Engr., U. S. Forest Service, 551 Columbia Ave., Pomona, Calif.

Rittman, Henry Thomas, Jr. (Jun. '37), Care, Acme Explosives Co., 612½ Ohio St., Terre Haute, Ind.

Roberts, Kenneth Lindsey (Assoc. M. '38), Associate Conservationist, U. S. Forest Service (Res., 335 Prospect St.), New Haven, Conn.

Rochlin, Sidney (Jun. '38), Structure Insp., State Highway Dept., 1542 West Adams, Phoenix, Ariz.

Roesch, Theophil (Assoc. M. '38), Draftsman and Designer, State Highway Comm., Bridge Dept. and Building Div. (Res., 934 East 57th St.), Indianapolis, Ind.

Santenbacher, William Phillip (Jun. '37), Engr., Forster-Wernert-Taylor (Res., 3714 Willys Parkway), Toledo, Ohio.

Scholer, Walter, Jr. (Jun. '37), 1114 State St., La Fayette, Ind.

Scholes, Thomas Francis (Jun. '37), Asst., Eng. Corps., P.R.R., 515 North 13th, Harrisburg, Pa.

Seitz, Bradley George (Jun. '38), Junior Engr., U. S. Engr. Office, 27 Willard St., Binghamton, N.Y.

Sights, Ernest Earl (Jun. '37), 732 South 15th St., Lincoln, Nebr.

Simpson, William McCray (Jun. '37), Care, Armour Inst. of Technology, 3300 Federal St., Chicago, Ill.

Solander, Arvo Axel (Jun. '38), Engr., Samuel M. Ellsworth, 457 Washington St., Newton, Mass.

Stone, Theron Burnham (Jun. '37), Foreman, State Highway Dept., Yakima, Wash.

Sumner, Leslie Graham (M. '38), Engr. of Bridges and Structures, State Highway Dept., Hartford (Res., 36 Middlefield Drive, West Hartford), Conn.

Thompson, George Roberg (M. '37), Cons. Engr. and Budget Director State of Michigan (Res., 3437 Edison Ave.), Detroit, Mich.

Thompson, Samuel Hyde (Assoc. M. '37), Engr., Federal Power Comm. (Res., 3515 R St., N. W.) Washington, D.C.

Veigel, Louis Walter (Jun. '38), County Engr. Stark County; City Engr., Dickinson, N.Dak.

Walker, James Matt (Jun. '38), Office Engr., Tarrant County, Care, County Engr. Dept., Court House, Fort Worth, Tex.

Walker, William Sefton (Jun. '37), Prof. Structural Eng. Dept., Linsly Inst. of Technology, Wheeling, W.Va.

Weatherby, Marion Everette, Jr. (Jun. '37), Asst. Eng. Draftsman, TVA, 2513 Parkview Ave., Knoxville, Tenn.

Zeigler, William Lewis (Assoc. M. '38), 302 East Broad St., Bethlehem, Pa.

Membership Transfers

Andrews, Eric Alexis (Jun. '28; Assoc. M. '32; M. '38), Asst. Engr. in Chg. of Sewers, Dept. of Public Works, City Hall (Res., 85 Rockledge Ave.), White Plains, N.Y.

Ashbridge, Whitney (Jun. '26; Assoc. M. '38), 610 Real Estate Trust Bldg., Philadelphia, Pa.

Coburn, Charles Lyman (Assoc. M. '29; M. '38), Associate Civ. Engr., Met. Dist. Water Supply Comm., 20 Somerset St., Boston (Res., 31 Percy Rd., Lexington), Mass.

Cocco, Miguel Angel (Assoc. M. '28; M. '38), 224 West 57th St., New York, N.Y.

Cook, Robert Elton (Jun. '30; Assoc. M. '37), Asst. Engr., U. S. Geological Survey, Room 3, U. S. Court House, Santa Fé, N.Mex.

Crow, Thomas Otho (Jun. '30; Assoc. M. '37), Junior Bridge Constr. Engr., State Div. of Highways, Bridge Dept., Box 773, Red Bluff, Calif.

Doherty, Charles Francis (Jun. '27; Assoc. M. '37), Prin. Engr., WPA, under Public Works Officer, New York Navy Yard, Brooklyn (Res., 52 Jefferson St., Nyack), N.Y.

Engel, Harry John (Jun. '26; Assoc. M. '38), Asst. Engr., Modjeski & Masters, State St. Bldg., Harrisburg, Pa.

Golzé, Alfred Rudolf (Jun. '32; Assoc. M. '38), Superv. Engr., CCC, U. S. Bureau of Reclamation, Dept. of the Interior, Washington, D.C. (Res., 152 Custer Rd., Bethesda, Md.).

Gongwer, James Minnick (Jun. '27; Assoc. M. '29; M. '38), Cons. Engr. (Thos. W. Marshall & James M. Gongwer), 1147 Connecticut Ave. (Res., 853 Van Buren St., N.W.), Washington, D.C.

Grime, Leonard (Jun. '28; Assoc. M. '38), Structural Draftsman, Hamilton Bridge Co. (Res., 145 Hess St., South, Apartment 11), Hamilton, Ontario, Canada.

Hein, Peter Leo (Assoc. M. '19; M. '38), (Lieberman & Hein), 190 North State St., Chicago, Ill.

Herzberg, Noble William (Jun. '35; Assoc. M. '38), Asst. Engr., U. S. Geological Survey, 636 Security Mutual Bldg. (Res., 54 Orton Ave.), Binghamton, N.Y.

Huber, Earl Raymond (Jun. '24; Assoc. M. '29; M. '38), Bridge Engr., Region 5, U. S. Forest Service, Phelan Bldg., San Francisco, Calif.

Huffine, William Byrd (Jun. '32; Assoc. M. '38), Associate Highway Engr. and Bureau Mgr., State-Wide Highway Planning Survey, Bureau of Public Roads, U. S. Dept. of Agriculture, Box 614, Cheyenne, Wyo.

Hughes, Leaton Lewis (Jun. '33; Assoc. M. '38), Structural Designer, Iowa-Illinois Power & Light Co. (Res., 1204 North 8th), St. Louis, Mo.

Huie, Albert Van Arnam (Jun. '31; Assoc. M. '38), Engr., Madigan-Hyland, 521 Fifth Ave., New York, N.Y. (Res., 16 Lexington Ave., Greenwich, Conn.)

Kennedy, George Donald (Assoc. M. '26; M. '37), Deputy State Highway Commr., State Highway Dept., Lansing (Res., 225 Chesterfield Parkway, East Lansing), Mich.

McGrew, Edward Josephus, Jr. (Jun. '27; Assoc. M. '33; M. '38), Deputy Commr., Dept. of Public Works, City of New York, Room 1800 Municipal Bldg., New York, N.Y.

Minear, Virgil Luther (Assoc. M. '30; M. '38), Associate Engr., U. S. Bureau of Reclamation, Room 440 U. S. Customs Bldg., Denver, Colo.

Moore, Norman Robert (Jun. '28; Assoc. M. '31; M. '38), Engr., U. S. Engr. Office, Vicksburg, Miss.

Newmark, Nathan Mortimore (Jun. '34; Assoc. M. '38), Research Asst. Prof., Civ. Eng., Univ. of Illinois, 119 Materials Testing Laboratory, Univ. of Illinois, Urbana, Ill.

Noble, Mont Cagley (Assoc. M. '26; M. '38), Gen. Mgr., The W. Q. O'Neall Co. of Illinois, 631 Princeton Ave., Springfield, Ill.

Norton, Irwin Gilbert (Assoc. M. '31; M. '38), Cons. Engr. and Archt., Walter F. Schulz, 870 Shrine Bldg., Memphis, Tenn.

Perkins, Henry Harvie (Jun. '25; Assoc. M. '38), Dist. Adviser, Bureau of Air Commerce, Airport Section, U. S. Dept. of Commerce, Washington, D.C.

Roberts, Elliott Burgess (Jun. '22; Assoc. M. '27; M. '38), Hydrographic and Geodetic Engr., U. S. Coast and Geodetic Survey, Washington, D.C.

Rosenberg, Samuel (Assoc. M. '27; M. '38), Res. Engr., State Dept. of Public Works, 122 West Main St., Babylon (Res., 142 Caryl Ave., Yonkers), N.Y.

Schutz, Max Adolf (Assoc. M. '29; M. '38), Structural Engr., Great Lakes Steel Corporation (Res., 512 West Grand Boulevard), Detroit, Mich.

Shah, Dhirajlal Somchand (Jun. '31; Assoc. M. '37), Asst. Engr., G. B. S. Rys., Mehsana (North Gujrat), India.

Stewart, William Paul (Jun. '28; Assoc. M. '38), Senior Constr. Insp., State Dept. of Highways, 1427 Chew St., Allentown (Res., 1036 Hampden Boulevard, Reading), Pa.

Thompson, John Cavett (Jun. '33; Assoc. M. '38), Associate Engr., U. S. Bureau of Reclamation, Marshall Ford Dam, Tex.

Thurber, Paul (Jun. '33; Assoc. M. '37), San. Engr., Panhandle Dist., State Dept. of Public Health, Box 243, Guymon, Okla.

Tilly, Ray Virgil (Assoc. M. '28; M. '37), Cons. Engr. (Wood, Walraven & Tilly), 322½ South 6th St. (Res., 1608 Noble Ave.), Springfield, Ill.

Ulrich, Franklin Peter (Assoc. M. '30; M. '38), Chf. Seismological Field Survey, U. S. Coast and Geodetic Survey, 75 Appraisers Bldg., San Francisco, Calif.

Updyke, Gerald Austin (Jun. '30; Assoc. M. '37), Chf. Draftsman, Atlantic, Gulf & Pacific Co., Box 626, Manila, Philippine Islands.

Vanderhout, William (Jun. '28; Assoc. M. '38), Sales Engr., The Austin Co., 19 Rector St., New York, N.Y.

West, Gordon Russell (Assoc. M. '30; M. '38), Reclamation Engr., Mo. Pac. Lines, Houston, Tex.

Wiedenhoeffer, Edgar Paul (Jun. '30; Assoc. M. '38), Asst. Prof., Civ. Eng., Michigan Coll. of Min. and Technology, Houghton, Mich.

Willis, William Prey (Assoc. M. '23; M. '38), Chf. Engr., Baytown Refinery, Humble Oil & Refining Co., Main Office Bldg., Humble Co., Baytown, Tex.

Zack, Samuel Isador (Assoc. M. '30; M. '38), San. Engr., Filtration Equipment Corporation, 10 East 40th St., New York, N.Y.

Reinstatements

Fisher, James Clarence, Assoc. M., reinstated Feb. 15, 1938.

Gidley, Louis Paul, Jun., reinstated Feb. 10, 1938.

Grieve, John, Assoc. M., reinstated Mar. 7, 1938.

Oakley, Thomas Denton, Assoc. M., reinstated Feb. 28, 1938.

Peters, William Frederick, Assoc. M., reinstated Feb. 28, 1938.

Resignations

Alper, Albert, Jun., resigned Mar. 1, 1938.

Benway, Percy Leroy, Assoc. M., resigned Mar. 4, 1938.

Coulcher, George Edwin Bohun, M., resigned Feb. 24, 1938.

Cresson, William James, Jr., Jun., resigned Feb. 17, 1938.

Klatzko, William, Jun., resigned Feb. 9, 1938.

Louison, Ben Howe, Assoc. M., resigned Feb. 9, 1938.

Morton, Carroll Tracy, Assoc. M., resigned Feb. 14, 1938.

Tarnay, Joseph, Assoc. M., resigned Feb. 14, 1938.

Titus, Herbert Chase, Affiliate, resigned Feb. 24, 1938.

White, John Comly, Assoc. M., resigned Feb. 23, 1938.

Wood, Robert Julian, Assoc. M., resigned Feb. 15, 1938.

Zilly, Herbert Carl, Jun., resigned Mar. 3, 1938.

Applications for Admission or Transfer

Condensed Records to Facilitate Comment of Members to Board of Direction

April 1, 1938 NUMBER 4

The Constitution provides that the Board of Direction shall elect or reject all applicants for admission or for transfer. In order to determine justly the eligibility of each candidate, the Board must depend largely upon the membership for information.

Every member is urged, therefore, to scan carefully the list of candidates published each month in CIVIL ENGINEERING *and to furnish the Board with data which may aid in determining the eligibility of any applicant.*

It is especially urged that a definite recommendation as to the proper grading be given in each case, inasmuch as the grading must be based upon the opinions of those who know the applicant personally as well as upon the nature and extent of his professional experience. Any facts derogatory to the personal character or professional reputation of an applicant should be promptly communicated to the Board.

Communications relating to applicants are considered strictly confidential.

The Board of Direction will not consider the applications herein contained from residents of North America until the expiration of 30 days, and from non-residents of North America until the expiration of 90 days from the date of this list.

MINIMUM REQUIREMENTS FOR ADMISSION

GRADE	GENERAL REQUIREMENT	AGE	LENGTH OF ACTIVE PRACTICE	RESPONSIBLE CHARGE OF WORK
Member	Qualified to design as well as to direct important work	35 years	12 years*	5 years of important work
Associate Member	Qualified to direct work	27 years	8 years*	1 year
Junior	Qualified for sub-professional work	20 years†	4 years*	
Affiliate	Qualified by scientific acquirements or practical experience to cooperate with engineers	35 years	12 years*	5 years of important work
Fellow	Contributor to the permanent funds of the Society			

* Graduation from an engineering school of recognized reputation is equivalent to 4 years of active practice.

† Membership ceases at age of 33 unless transferred to higher grade.

The fact that applicants refer to certain members does not necessarily mean that such members endorse.

ADMISSIONS

BARGAR, JOSEPH LOWELL, Harlem, Mont. (Age 27.) Asst. Engr. (Civ.), with U. S. Engr. Office, Ft. Peck Dist. Refers to T. B. Larkin, N. T. F. Stadtfeld.

BICKFORD, KENNETH KEVIN, San Francisco, Calif. (Age 24.) Jun. Bridge Engr. and Inspector on Railroad Construction, San Francisco–Oakland Bay Bridge. Refers to E. C. Flynn, G. L. Sullivan, H. Whipple.

BINGHAM, WILLIAM FREDERIC, Denver, Colo. (Age 44.) Engr. with U. S Bureau of Reclamation. Refers to H. K. Barrows, K. B. Keener, E. W. Lane, E. A. Moritz, R. A. See, B. W. Steele.

BRIGGS, ARTHUR ALLEN, Bryan, Tex. (Age 26.) Refers to J. T. L. McNew, J. J. Richey.

BRINKLER, JOHN STANLEY, Buffalo, N.Y. (Age 32.) Topographic Draftsman, War Dept., U. S. Engr. Office. Refers to R. W. Burpee, L. L. Davis, G. Gilboy, E. Mirabelli, D. Peabody, Jr., G. E. Russell, H. C. Woods.

BURNHAM, ALONZO KNOWLTON, Dumont, N.J. (Age 47.) Div. Engr., Atlantic Div., Great Lakes Dredge & Dock Co. Refers to F. R. W. Cleverdon, W. P. Feeley, E. P. Goodrich, E. B. Snell, R. N. Spooner, C. E. Trout.

BURTON, JAMES EDWARD, Topeka, Kans. (Age 30.) Associate Engr., Highway Planning Dept., Kansas State Highway Comm. Refers to C. M. Barber, H. D. Barnes, T. E. Burton, W. K. Dinklage, R. D. Finney, H. M. Swope.

CASCINO, DAVID DOMINIC, Garfield, N.J. (Age 24.) Structural Engr. with Foster-Wheeler Eng. Corporation, New York City. Refers to A. M. Erkinson, C. L. Harris.

COLLINS, HOWARD WILLIAM, Port Arthur, Texas. (Age 22.) Draftsman, The Texas Co. Refers to P. Campbell, Jr., L. B. Ryon, Jr., W. E. White.

CULLITY, MARTIN JOSEPH, JR., Arlington, Mass. (Age 28.) Engr. with Earl C. Magoun, Contr. Refers to C. R. Bliss, L. Gurney, G. S. Hewins, O. H. Horovitz, H. Nawn.

DAVIES, SAMUEL LADD, Morrilton, Ark. (Age 23.) Engr. Arkansas State Board of Health. Refers to N. B. Garver, W. R. Spencer.

DRAKE, GILBERT GEORGE, Seattle, Wash. (Age 27.) Refers to F. B. Farquharson, R. G. Hennes, A. L. Miller, C. C. More, F. H. Rhodes, Jr.

FOX, ROBERT WALDO, Fort Smith, Ark. (Age 38.) Project Engr., Land Development Sec., Land Utilization Div., Bureau of Agricultural Economics, U. S. Dept. of Agriculture. Refers to J. H. Gardiner, J. F. W. Gebhardt, H. E. Nunn, J. R. Rhyne, T. B. Shertzer, R. von Fabrice, W. L. Winters.

GARINO, MERLE WARD, Oakland, Calif. (Age 24.) Refers to H. H. Bruck, C. G. Hyde.

GIRAND, JOHN GOODMAN, Phoenix, Ariz. (Age 31.) Designing Engr., Showlow Irrigation Dist. Refers to S. A. Erickson, F. R. Goodman, A. F. Harter, V. H. Housholder, W. Johannessen, M. R. Keefe, G. M. Kilcarr, H. S. Reed, L. A. Robb.

GLOSTER, ARTHUR SPEARS, Norris, Tenn. (Age 34.) With TVA on Norris Dam. Refers to C. M. Dubois, B. M. Jones, A. M. Komora, C. D. Riddle, G. R. Smiley, I. L. Tyler, R. White.

GRIBOK, PETER, New York City. (Age 21.) Refers to W. Allan, R. E. Goodwin.

HATCH, GRIFFIN MCFIE, JR., Dallas, Tex. (Age 29). San. Engr. and Asst. Chf., Inspection and San. Div., Public Health Dept. Refers to J. T. Conroy, E. Couch, G. E. Franklin, K. F. Hoefle, J. T. L. McNew, J. A. Orr, J. J. Richey, A. P. Rollins, C. E. Sandstedt.

HEBERT, GREGORY MACDONALD, Tulsa, Okla. (Age 26.) Refers to W. C. Huntington, J. Vawter.

HEDLEY, WILLIAM JOSEPH, University City Mo. (Age 35.) Constr. Engr. with Wabash Ry. Co., St. Louis, Mo. Refers to R. B. Brooks, B. L. Brown, R. H. Ford, E. M. Hastings, W. A. Heimbuecher, A. Lewald, R. L. Longshore, F. E. Morrow, J. H. Porter, E. O. Sweetser.

HEIN, WALTER EDWARD, St. Charles, Ill. (Age 24.) Refers to J. J. Doland, W. C. Huntington, G. W. Pickels, T. C. Shedd, J. Vawter, C. C. Wiley.

HUTCHINGS, JOHN BACON, JR., Asheville, N.C. (Age 57.) With Chas. E. Waddell on hydraulic studies for TVA. Refers to J. S. Bowman, L. M. Cox, W. R. Crute, J. Dave, R. J. Rosenberger, C. E. Waddell.

HUTCHINSON, RICHARD BELL, Jobstown, N.J. (Age 29.) Research Engr., U. S. Pipe & Foundry Co. Refers to G. E. Beggs, W. R. Conard, L. A. Robb, E. K. Timby, T. H. Wiggin.

KRAWITZ, IRA, Rock Island, Ill. (Age 26.) Jun. Engr., U. S. Engr. Corps. Refers to T. D. Holloway, J. E. Jewett, H. A. Vagtborg.

KRIVO, ALBERT A, Urbana, Ill. (Age 23.) Refers to J. S. Crandell, J. J. Doland, A. Epstein, W. C. Huntington, G. W. Pickels, T. C. Shedd, J. Vawter.

LAMBERT, HOWARD WILLIAM, Weeks, Nev. (Age 27.) Acting Supt., U. S. Dept. of Interior, Div. of Grazing. Refers to F. L. Bixby, H. P. Boardman, J. C. Fales.

LARSON, BERNT OSCAR, Champaign, Ill. (Age 24.) Refers to W. C. Huntington, T. C. Shedd.

LESLIE, ALEXANDER, Edinburgh 4, Scotland. (Age 27.) Asst. Engr. with J. & A. Leslie & Reid, Civ. Engrs., Edinburgh, Scotland. Refers to A. Gibb, G. Richards, B. W. Tawse. (Applies in accordance with Sec. 1, Art. I, of the By-Laws.)

LOUD, EDWARD INMAN, JR., Weymouth, Mass. (Age 22.) Jun. Eng. Aid, Commonwealth of Massachusetts. Refers to H. P. Burden, F. N. Weaver.

LYELL, HERBERT LESLIE, Palo Alto, Calif. (Age 28.) Refers to S. B. Morris, L. B. Reynolds, E. L. Soule, E. C. Thomas, J. B. Wells.

MCINNIS, JOHN LAWSON, JR., Birmingham, Ala. (Age 22.) Refers to B. W. Pegues, F. F. Pillet.

MADDEN, WILLIAM FRANCIS, Cortland, N.Y. (Age 40.) Engr. with Carl W. Clark, Archt. Refers to F. A. Barnes, G. F. Fisk, M. E. Gilmore, W. W. Johnston, A. S. Tuttle, C. L. Walker.

MARCUS, LAWRENCE ROGERS, Urbana, Ill. (Age 24.) Refers to J. J. Doland, W. C. Huntington, F. E. Richart, T. C. Shedd, J. Vawter.

MUNSON, GEORGE POINDEXTER, JR., Mt. Vernon, Tex., (Age 30.) Asst. Res. Engr., Texas State Highway Dept. Refers to L. D. Cabaniss, C. C. Cagle, F. M. Davis, M. Hannah, A. D. Hutchinson, J. E. Pirie.

PARME, ALFRED LUCIEN, Binghamton, N.Y. (Age 28.) Asst. Engr., U. S. Army Engrs. Refers to W. B. E. Anthony, P. C. Gillette, E. M. Graf, W. L. Kuehnle, G. R. Williams.

PITNER, ROY MITCHELL, JR., Houston, Tex. (Age 25.) Chainman, Stanolind Oil & Gas Co. Refers to L. B. Ryon, Jr., C. F. Weddington.

POOLE, WILLIAM CLAYTON, Port Arthur, Tex. (Age 33.) Test and Records Engr., The Texas Co. Refers to P. Campbell, Jr., M. Halpern, C. M. Harless, H. C. Hose, W. C. Mundt.

RAUCH, HENRY ALBERT, Dayton, Ohio. (Age 26.) Civ. Engr. with National Cash Register Co. Refers to C. J. Belz, E. O. Brown, J. J. Chamberlain, Jr., G. V. Clow, B. T. Schad.

REECE, KEMP WILSON, New York City. (Age 34.) Asst. Engr., Phoenix Eng. Corporation. Refers to D. W. Cole, N. B. Jacobs, A. T. Larned, W. S. Merrill, M. B. Moore, Jr., C. N. Phillips, M. R. Scharff.

REICKERT, FREDERICK ARTHUR, New Haven, Conn. (Age 30.) Refers to C. T. Bishop, H. Cross, D. P. Krynine, T. R. Lawson, H. O. Sharp.

REISS, LOUIS, Brooklyn, N.Y. (Age 33.)

Supt. of Field Forces with WPA. Refers to A. Dick, W. J. Gillen, D. W. Krellwitz, R. T. Lassiter, F. G. Parisi.

Reitz, Ben Bone, New York City. (Age 21.) Refers to W. Allan, R. E. Goodwin, J. C. Rathbun.

Roth, Charles Oliver, Jr., North Plainfield, N.J. (Age 35.) Instructor in Civ. Eng., Cooper Union, New York City. Refers to F. M. Dawson, J. S. Dodds, F. E. Foss, H. K. Preston, P. P. Rice, W. C. Taylor, D. S. Trowbridge.

Schiff, Louis, Bronx. N.Y. (Age 26.) Refers to J. S. Crandell, T. C. Shedd, J. Vawter.

Searl, Thomas Dickinson, New York City. (Age 58.) Chf. Constr. Engr., George A. Fuller Co. Refers to H. G. Balcom, F. N. Benedict, W. R. Hillyer, C. S. Proctor, N. A. Richards, H. V. Spurr, T. K. Thomson.

Shea, Carter Laurence, Flushing, N.Y. (Age 21.) Civ. Engr. with Frederick Snare Corporation. Refers to A. A. Chamberlain, H. Englander, T. R. Lawson, G. E. F. Lund, H. O. Sharp, L. E. Stephenson, E. R. Wiseman.

Sheahan, Harold Vose, Somersworth, N.H. (Age 56.) Member of firm, and Treas., Ames-Sheahan, Inc. Refers to E. W. Bowler, H. M. Bryant, G. W. Case, J. W. Childs, F. E. Everett, G. A. Sampson.

Slichter, Francis Benjamin, Kansas City. Mo. (Age 33.) Civ. Engr. with U. S. Engr. Dept., Kansas City, Mo., Dist., Missouri River Div. Refers to G. B. Archibald, W. Gerig, G. A. Hathaway, D. H. McCoskey, T. Merriman, C. W. Sturtevant.

Smith, John Edward, Marion, Mass. (Age 29.) Rodman and Chainman, Stone & Webster Constr. Co. Refers to H. P. Burden, R. W. LeFavour, F. N. Weaver.

Solnar, George Edwin, Jr., Fresno, Calif. (Age 24.) Refers to L. B. Reynolds, H. A. Williams.

Stedje, John Jay, Chicago, Ill. (Age 51.) Engr. of Structural Design, Board of Local Improvements. Refers to J. D'Esposito, A. Engh, G. Jeppesen, C. C. Muhs, E. Weidemann.

Stickle, Samuel Dark, Brooklyn, N.Y. (Age 30.) Asst. Div. Engr., Atlantic (N.Y.) Div., Great Lakes Dredge & Dock Co. Refers to L. L. Davis, W. P. Feeley, E. B. Snell, C. E. Trout, H. C. Woods.

Swisher, Louis Mearns, Williamstown, W.Va. (Age 23.) Refers to R. P. Davis, W. S. Downs.

Thomas, Ralph G, Los Angeles, Calif. (Age 53.) Dist. Engr., Dept. of Bldg., Los Angeles County, Calif. Refers to S. B. Barnes, C. N. Dirlam, W. J. Fox, E. Maag, W. E. Wilson.

Travis, Charles French, New York City. (Age 30.) Asst. and Associate Engr., North Atlantic Div., U. S. Engrs., being Asst. to Chf. of Flood-Control Sec. Refers to C. E. Boesch, T. S. Burns, F. B. Harkness, T. T. Knappen, E. L. Winslow, Jr.

Tyburski, Edward Adam, Schenectady, N.Y. (Age 26.) With Town of Rotterdam in charge of engineering. Refers to W. W. Chadsey, E. Devendorf, W. C. Taylor.

Valentine, Claude Henry, Brooklyn, N.Y. (Age 48.) Deputy Tax Commr. Refers to W. Burton, J. J. McGinley, S. Negrey, W. C. Rohdenburg, L. S. Stiles, T. K. Thomson.

Vought, Harry, Jamaica, N.Y. (Age 35.) Associate Engr., WPA. Refers to A. M. Anderson, L. M. Charm, M. E. Gilmore, A. K. Johnson, A. B. Kozma, R. S. Raaberg, E. W. Wolf.

Waldenmaier, Bernhardt Albert, Fayetteville, N.C. (Age 42.) State Field Engr., North Carolina WPA., Raleigh, N.C. Refers to L. T. Andrus, O. B. Bestor, F. Coffman, J. G. Coxetter, C. L. Mann, J. D. Spinks.

Warren, Frank Manley, Jr., Portland, Ore. (Age 22.) Statistical Engr. with Portland Gen. Electric Co. Refers to J. P. Newell, J. H. Polhemus, W. L. Sharp.

Whitaker, Robert Lynn, Fort Wayne, Ind. (Age 36.) Constr. Engr., Gen. Elec. Co. Refers to L. T. Ericson, A. S. Forster, L. M. Gram, H. E. Riggs, R. E. Simpson, J. W. Wopat.

Whittington, Russell Rowe, El Paso, Tex. (Age 32.) Constr. Engr., Gen. Eng. Dept., El Paso, with American Smelting & Refining Co. Refers to S. F. Crecelius, R. G. Hosea, L. M. Lawson, T. G. M . Carthy, V. J. Von Schoeler, W. A. Von Schoeler.

Woffenden, Richard, Keighley, Yorkshire, England. (Age 38.) Asst. Engr., Borough of Keighley, Yorkshire, England. Refers to R. A. Black, G. T. Donoghue, W. J. Howard, L. Petersen, H. E. Wessman.

Wood, William Howell, Austin, Tex. (Age 41.) Administrative Head of Div. of Materials and Tests, Texas State Highway Div. Refers to J. A. Focht, G. Gilchrist, T. E. Huffman, T. J. Kelly, J. T. L. McNew, A. H. Pollard, H. C. Porter.

Woodward, Douglas Russell, Albany, N.Y. (Age 26.) Jun. Engr., Water Resources Branch, U. S. Geological Survey. Refers to E. W. Bowler, G. W. Case, A. W. Harrington, H. Johnson, R. R. Skelton, P. R. Speer, F. P. Williams.

Yatsko, Michael, New York City. (Age 22.) Refers to W. Allan, R. E. Goodwin, T. H. Prentice.

Zaborowski, Robert, Urbana, Ill. (Age 20.) Refers to J. J. Doland, T. C. Shedd.

FOR TRANSFER

FROM THE GRADE OF ASSOCIATE MEMBER

Daniels, Francis Wallin, Assoc. M., Shaker Heights, Ohio. (Elected June 9, 1930.) (Age 39.) Chf. Engr., The H. K. Ferguson Co. Refers to W. L. Havens, H. S. Jacoby, J. T. Moore, R. N. Shepard, O. C. Spurling, R. E. J. Summers, H. A. Wilson.

Freeburn, Harry Mortimer, Assoc. M., Philadelphia, Pa. (Elected October 1, 1926.) (Age 42.) Dist. Engr. in charge of Philadelphia Dist. Office, Pennsylvania Dept. of Health. Refers to C. E. Davis, C. A. Emerson, Jr., F. S. Friel, C. Haydock, H. E. Moses, R. O'Donnell, W. L. Stevenson.

Griffin, Guy Eben, Assoc. M., Greenwich Conn. (Elected Jan. 28, 1935.) (Age 38.) San. Engr., Sewer Comm. Refers to H. P. Burden, E. S. Chase, S. M. Ellsworth, G. M. Fair, A. L. Fales, A. D. Weston.

Marks, Edwin Hall, Assoc. M., Buffalo, N.Y. (Elected Junior Sept. 3, 1913; Assoc. M. Sept. 12, 1916.) (Age 50.) Lt.-Col., Corps of Engrs., U. S. Army; Dist. Engr., U. S. Engr. Office. Refers to L. M. Adams, C. deB. Christie, C. L. Hall, W. Kelly, E. P. Lupfer, E. N. Noyes, M. C. Tyler, F. B. Wilby.

Pettus, Leslie Alexander, Assoc. M., St. Louis, Mo. (Elected July 8, 1935.) (Age 44.) Div. Engr. with city of St. Louis. Refers to A. H. Baum, Jr., W. C. E. Becker, B. L. Brown, R. P. Garrett, E. H. Paffrath, C. W. S. Sammelman, L. J. Sverdrup.

Rector, Nelson Hamilton, Assoc. M., Jackson, Miss. (Elected Nov. 12, 1928.) (Age 38.) With State Board of Health and U. S. Public Health Service on malaria-control work. Refers to J. S. Allen, D. H. Barber, G. R. Clemens, W. E. Elam, L. L. Hidinger, G. H. Matthes, J. T. Thompson.

Renshaw, John Arthur, Assoc. M., Springfield, Pa. (Elected Aug. 29, 1927.) (Age 49.) Res. Engr. Inspector, FAPW, Philadelphia, Pa. Refers to M. B. Case, W. H. Gravell, S. Harris, W. R. Scanlin, S. Smith, C. H. Stevens, W. E. Witte.

Scruggs, Edwin Lyle, Assoc. M., Lancaster, S.C. (Elected April 14, 1919.) (Age 48.) Chf. Engr. and Director, The Springs Cotton Mills. Refers to C. B. Brown, F. H. Cothran, H. K. Hood, A. C. Lee, T. K. Legare, D. F. Noyes, J. R. Peavy, O. Z. Wrenn.

Seemann, Ernest Warren, Assoc. M., New York City. (Elected Nov. 12, 1928.) (Age 43.) Project Mgr., Merritt-Chapman & Scott Corporation. Refers to F. S. Altman, F. W. Barnes, G. H. Butler, Sr., M. S. Grytbak, N. C. Holdredge, E. P. Lupfer, L. M. Mitchell, J. G. Tripp.

Stubbs, Frank Whitworth, Jr., Assoc. M., Kingston, R.I. (Elected Aug. 29, 1927.) (Age 39.) Prof. of Civ. Eng., and Head of Dept., Rhode Island State Coll. Refers to A. J. Boase, I. C. Crawford, H. Cross, C. L. Eckel, M. L. Enger, W. C. Huntington, H. T. Larsen.

From the Grade of Junior

Baihly, William Edington, Jun., Seattle, Wash. (Elected Feb. 19, 1934.) (Age 32.) Stress Engr., Boeing Aircraft Co. Refers to R. M. Harris, G. E. Hawthorn, A. L. Miller, F. H. Rhodes, Jr., R. G. Tyler.

Beer, Robert Gardiner, Jun., Brooklyn, N.Y. (Elected Oct. 1, 1928.) (Age 31.) Asst. Prof. of Civ. Eng., Polytechnic Inst. of Brooklyn. Refers to H. R. Codwise, R. Evers, H. P. Hammond, L. F. Rader, E. J. Squire.

Brown, Ralph Charles, Jun., Albertville, Ala. (Elected Oct. 26, 1931.) (Age 32.) Res. Engr. with TVA. Refers to W. N. Downey, H. L. Fruend, E. Harsch, J. E. Moreland, F. W. Webster, H. A. Wiersema.

Buerkle, Herbert Cosmos, Jun., Newark, N.J. (Elected Oct. 24, 1932.) (Age 32.) Asst. Civ. Engr., Essex County Highway Dept. Refers to F. E. Caspar, H. N. Cummings, S. C. Hamilton, Jr., H. A. Haufler, W. S. LaLonde, Jr.

Campbell, Richard Trent, Jun., San Antonio, Tex. (Elected July 23, 1934.) (Age 27.) With Mosher Steel Co. as Representative in charge of San Antonio Sales Office and South Texas Territory. Refers to O. V. Adams, G. A. Field, L. C. Ingram, Jr., J. H. Murdough, H. N. Roberts, M. W. Sherman, W. E. Simpson.

Edwards, Frank William, Jun., New Orleans, La. (Elected April 7, 1930.) (Age 32.) Chf., Hydr. Sec., 2d U. S. Engr. Office, New Oreleans, La. Refers to A. L. Alin, F. C. Carey, F. T. Mavis, N. R. Moore, C. M. Stanley, C. C. Williams, H. L. Williams.

Erickson, Eriek Boine, Jun., Washington, D.C. (Elected Nov. 9, 1936.) (Age 32.) Jun. San. Engr., Constr. Div., Resettlement Administration (FSA). Refers to H. W. Bressler, K. K. King, C. C. Singleton, R. P. Strickland, F. C. Zeigler.

Holdampf, Carl Richard, Jun., Milwaukee, Wis. (Elected Feb. 23, 1932.) (Age 32.) With C. S. Whitney, Milwaukee, Wis. Refers to J. L. Ferebee, W. J. Fuller, C. V. Seastone, S. M. Siesel, C. N. Ward, C. S. Whitney.

Josephs, Arthur Cook, Jun., New York City. (Elected Oct. 1, 1928.) (Age 31.) Designer, Phoenix Eng. Corporation. Refers to H. K. Barrows, A. T. Larned, W. S. Merrill, A. A. Meyer, C. E. Pearce, C. M. Spofford, H. Sutherland.

Kohli, Charles Brice, Jun., Bluffton, Ohio. (Elected Nov. 11, 1929.) (Age 30.) Asst. Civ. Engr., Bureau of Air Commerce, Dept. of Commerce, Washington, D.C. Refers to G. H. Elbin, H. A. Hook, S. H. McCrory, G. E. Stratton, A. R. Webb.

Leighton, Charles Kelton, Jun. Austin, Tex. (Elected Oct. 30, 1933.) (Age 31.) Asst. Location Engr. with Texas Highway Dept. Refers to J. P. Exum, E. W. Hester, M. P. von Homeyer, W. W. McClendon, R. J. McMahon, J. T. L. McNew, T. B. Warden.

McCasland, Stanford Paul, Jun., Fresno, Calif. (Elected July 14, 1930.) (Age 32.) Associate Engr. with U. S. Bureau of Reclamation. Refers to I. E. Flaa, S. O. Harper, J. R. Iakisch, S. B. Morris, L. B. Reynolds, J. Skytte, C. P. P. Vetter.

McMurray, Donald Irvine, Jun., Olympia, Wash. (Elected Oct. 1, 1928.) (Age 32.) Bridge Designer, State Bridge Dept. Refers to C. C. Arnold, C. E. Cleaver, R. W. Finke, R. C. Knapp, M. S. Woodin.

Morris, Theodore, Jun., Philadelphia, Pa. (Elected June 26, 1931.) (Age 32.) Asst. Engr. with Mountain Water Supply Co. Refers to W. H. Chorlton, W. S. Pardoe, J. A. Russell, A. R. Wilson, E. R. Winkler, Jr.

Ritter, Samuel Henry, Jun., Little Rock, Ark. (Elected Nov. 10, 1930.) (Age 32.) Associate Engr., War Dept., Corps of Engrs., U. S. Army. Refers to E. A. Blanpied, A. C. Bux, J. A. Johnson, R. O'Donnell, E. D. Walker.

Smith, Travis Logan, III, Jun., Houston, Texas. (Elected Nov. 18, 1935.) (Age 30.) Asst. City Engr. with Director of Public Works. Refers to R. P. Boyd, J. T. L. McNew, J. M. Nagle, W. A. Ortolani, A. P. Rollins, J. G. Turney.

Ware, Walter Justus, Jun., Kansas City, Mo. (Elected Oct. 26, 1931.) (Age 32.) Asst. Engr., U. S. Engineer Office. Refers to J. B. Butler, A. C. Bux, E. W. Carlton, G. A. Hathaway, D. H. McCoskey, H. K. Shane.

Weirich, Alfred Franklin, Jun., Columbia, Pa. (Elected Jan. 26, 1931.) (Age 32.) Safety Engr. with The Arundel Corporation. Refers to J. W. Bradner, Jr., H. T. Gerrish, H. R. Hall, A. N. Johnson, S. S. Steinberg.

Wells, Roger Milton, Jun., New York City. (Elected Nov. 11, 1929.) (Age 32.) Eng. Asst., Grade 3, Board of Water Supply. Refers to H. P. Barnes, H. R. Bouton, R. J. Clark, M. F. Freund, J. A. Johnson, O. W. Myers, W. W. Studdert.

Woods, Kenneth Brady, Jun., Columbus, Ohio. (Elected Nov. 26, 1934.) (Age 32.) Asst. Engr., Bureau of Tests, Ohio State Highway Dept., in charge of Soil Sec. Refers to H. H. Hawley, R. R. Litehiser, C. T. Morris, J. C. Prior, J. R. Shank, C. E. Sherman, W. G. Smith.

The Board of Direction will consider the applications in this list not less than thirty days after the date of issue.

Men Available

These items are from information furnished by the Engineering Societies Employment Service, with offices in Chicago, New York, and San Francisco. The Service is available to all members of the contributing societies. A complete statement of the procedure, the location of offices, and the fee is to be found on page 117 of the 1938 Year Book of the Society. To expedite publication, notices should be sent direct to the Employment Service, 31 West 39th Street, New York, N.Y. Employers should address replies to the key number, care of the New York Office, unless the word Chicago or San Francisco follows the key number, when it should be sent to the office designated.

Construction

Construction Engineer; Jun. Am. Soc. C.E.; 25; B.S. in C.E., 1933; single; with general building contractor $2^1/_2$ years as estimator, foreman, and structural designer. Familiar with PWA work, and flood rehabilitation and remodeling. Desires connection with contractor, architect, or building supplies industry. C-293.

Executive

Construction or Consulting Engineer; M. Am. Soc. C.E.; 54; married; 25 years on large works under able men. Experienced in work simplification, organization, construction plant, design and cost analysis—on rivers, dams, tunnels, conduits, and irrigation and drainage projects. Interested in short assignments anywhere; available on short notice. C-292-301-A-3 San Francisco.

Civil Engineer Executive; M. Am. Soc. C.E.; university graduate; married; 10 years design and construction of railroad structures; mass transportation studies; extensive valuation; 20 years in charge of department for large utility property including extensive rehabilitation program. Recently on reconstruction of railroad facilities on large bridge including GEO installation. Anywhere in United States. Now available. C-291.

Consulting Civil Engineer; M. Am. Soc. C.E.; 51; married; graduate of Rensselaer Polytechnic Institute; registered professional engineer, New York; 28 years experience, harbor work, industrial plants, power plants, oil refineries, bridges, and railroad work, United States and foreign countries. Reports and investigations a specialty. Available any locality; preferably consulting engineer or firm doing consulting work. C-294.

Executive; Assoc. M. Am. Soc. C.E.; graduate civil engineer with business training; 7 years general engineering work and 7 years resident on building construction. Will be valuable in an engineering or allied business. Industrious, trustworthy, tactful, a careful manager and ready to take responsibility. Location, northeastern United States C-296.

Planning Engineer; Assoc. M. Am. Soc. C.E.; American Society of Planning Officials. Educated in England; registered civil engineer, California; 25 years American and Canadian planning experience; 3 years regional planning executive, consultant to a number of cities. Since 1933 engaged in governmental planning activities. Desires work in city or state planning. Reports, surveys, planning, or housing programs. Highest references. C-300-85-A-2 San Francisco.

Civil Engineer; Assoc. M. Am. Soc. C.E.; graduate with 25 years experience in design and fabrication of steel buildings and bridges; also executive and administrative experience. Excellent references. Married. Available immediately for permanent position as chief engineer with fabricator, contractor, or engineer. Location immaterial. C-312.

Civil and Sanitary Engineer; M. Am. Soc. C.E.; C.E., Delft; C.P.H., Yale; 50; single; 9 years experience, Dutch and colonial governments in bridges, water power, sewerage, housing, docks, etc.; executive reports. American experience: 6 years on design of bridges, viaducts, foundations, sewerage; 4 years college engineering teaching; 1 year design mill buildings. Engineering or teaching position. Location anywhere. C-313.

Junior

Junior Engineer; 23; single; B.C.E. and M.C.E. degrees, School of Technology, College of the City of New York. Specialized in hydraulic engineering for master's degree. Received a fellowship and acted as field instructor in surveying. Desires work in hydraulic engineering. Has knowledge of Spanish. Free to travel. C-289.

Civil Engineer; Jun. Am. Soc. C.E.; 23; single; B.C.E. and M.C.E. Recent graduate with fine scholastic record. Desires position with a progressive firm doing construction or geological work. Has had surveying experience. Location immaterial; available immediately. C-290.

Civil and Mechanical Engineer; 24; B.S. C.E. and M.E.; 2 years architectural draftsman and construction supervisor; 6 months engineer in steel mills on heavy construction and installation of power plant and mechanical equipment. Desires position as assistant plant maintenance engineer, construction engineer, or draftsman. Can go to any location on short notice. Best references. C-295-8968 Chicago.

Engineer; Jun. Am. Soc. C.E.; 27; married; 2 years experience in irrigation construction; 2 years office engineering in state highway department; 2 years soil conservation engineering. Employed at present in private practice as partner to consulting engineer. Desires change. Available on short notice. C-297.

Civil Engineer; Jun. Am. Soc. C.E.; 26; married; B.S.C.E., 1936; 3 years surveying experience before graduation; 1 year junior engineer for government; work involved surveys, computation, land studies for agricultural purposes and for community use; 6 months with U. S. War Department; hydrographic and flood control surveys. Concrete construction experience. Desires position with future; free to travel. C-299.

Civil Engineer; Jun. Am. Soc. C.E.; 22; single; C.E., Rensselaer Polytechnic Institute; 4 months experience structural steel drafting; some field experience as rodman and transitman; 1 year experience in tank car drafting and some design. Willing to go anywhere. Available immediately. C-301.

Civil Engineer; Jun. Am. Soc. C.E.; B.S. C.E., Newark College of Engineering, 1937. Desirous of securing position, water supply, stream pollution, or sewage disposal—interested in making it a profession. Single; age 22; employed as assistant surveyor with oil company for 1 year. No preference in location. References; available on short notice. Located Newark, N.J. C-302.

Civil Engineer; Jun. Am. Soc. C.E.; 24; B.S.C.E., Cooper Union Institute of Technology; 3 months field work in plumbing inspection under U. S. Public Health Service. Previous diversified experience. Over year's service as topographic draftsman on flood control. Seeks opportunity to prove merit; locality anywhere outdoors or rural. C-303.

Civil Engineer; Jun. Am. Soc. C.E.; 31; married; B.S. in C.E., University of Pennsylvania, 1931; $6^1/_2$ years as engineer estimating and computing quantities for dams, mill and bridge foundations, docks, etc.; some design work; detailing of reinforcing steel and other phases of construction; also field experience on subway construction and railroads. Available at once. C-304.

Civil Engineer; Jun. Am. Soc. C.E.; 28; single; A.B. and C.E., Stanford University; member Sigma Xi; 3 years experience, design and construction of water-works units and appurtenant structures and purification plants. Desires change to job with better opportunity for experience and advancement. Available on reasonable notice. Location anywhere. C-305-334-A-1 San Francisco.

Civil Engineer; Jun. Am. Soc. C.E.; 23; single; B.S. in C.E. and C.E.; one-year fellowship as assistant instructor in civil engineering (surveying and materials testing laboratory); $1^1/_2$ years chief of party; 6 months estimator on heavy construction; desires permanent connection. Publicity or sales acceptable. Location immaterial. Excellent references. Available immediately. C-306.

Surveyor, Locating Engineer; Jun. Am. Soc. C.E.; 29; married; licensed surveyor, New York State; 10 years varied experience; 5 years general surveying, including experience in topographic branch, U. S. Geological Survey; 4 years on state and county highway surveys and construction; 1 year building construction. Desires permanent connection with engineering or contracting firm, public utilities. C-308.

Sanitary Engineer; Jun. Am. Soc. C.E.; 25; married; Christian; B.S. in C.E. from Yale in 1935; M.S. in sanitary engineering from Harvard, 1936; some experience in surveying and construction work; and one year in state department of public health; excellent references; available immediately; desires position in design, research, operator, chemist, or in related field. C-309.

Civil Engineer; Jun. Am. Soc. C.E.; 25; married; B.S.C.E., University of Michigan; 1 year experience as topographical draftsman; 9 months as structural draftsman. Desires position with future, preferably in structural engineering. Location in the East desirable; available on short notice. C-310.

Teaching

Civil Engineer; M. Am. Soc. C.E.; 37 years old; now in responsible charge of dam construction, including placing and testing a million yards of rolled earth fill, desires teaching position in civil engineering department of university with opportunity for work in soil mechanics. Location immaterial. Available September. C-307.

University Instructor; Assoc. M. Am. Soc. C.E.; desires position as assistant professor in surveying or sanitary engineering with opportunity for advancement; 15 years teaching experience. Master's degree in sanitary engineering from Cornell. C-311.

RECENT BOOKS

New books of interest to Civil Engineers donated by the publishers to the Engineering Societies Library, or to the Society's Reading Room, will be found listed here. A comprehensive statement regarding the service which the Library makes available to members is to be found on page 108 of the Year Book for 1938. The notes regarding the books are taken from the books themselves, and this Society is not responsible for them.

Index to A.S.T.M. Standards and Tentative Standards as of January 1, 1938. Philadelphia (Pa.), American Society for Testing Materials, 1938. 119 pp., 9 × 6 in., paper, gratis.

Both a classified index and a numerical list of all standards as of January 1, 1938, is given in this volume; these standards cover specifications, test methods, and definitions as adopted by the society.

Road Curves. By F. G. Royal-Dawson. London, E. & F. N. Spon, Ltd.; New York, Chemical Publishing Co., 1936. 246 pp., diagrs., charts, tables, 8 × 5 in., leather, $3.50.

This book contains practical solutions of curve design problems for modern traffic, explaining the setting out of transition curves on the basis of both the spiral and the lemniscate, the use of circular arcs, superelevation calculations, vertical curves, etc.

Steel Construction, 3 ed. New York, American Institute of Steel Construction (200 Madison Avenue), 1937. 398 pp., tables, diagrs., charts, 9 × 6 in., leather, $2

In the present edition of this manual, which was prepared under the supervision of the American Institute of Steel Construction Committee on Manual, all allowable loads have been recalculated in accordance with the Revised Specification (adopted by the Institute in June 1936 and published in pamphlet form) and are tabulated, together with such explanatory matter as seemed desirable. The other parts of the manual have been changed only where necessary to bring them up to date.